

## Declination as a phonetic property of utterances in Cantonese\*

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## 1 Defining declination

The pitch span in an intonation group<sup>1</sup> demonstrates a phenomenon of declination. Declination refers to the fundamental frequency having a tendency to decline gradually during the course of utterances (Ladd 1984: 53).

Declination is an  $F_0$ -decreasing phonetic process in Cantonese that is not subject to any particular tonal sequences. It differs from such phonological processes as downstep or downdrift in African languages. For example, Hyman (1975: 226) claims that an alternation of H-L-H sequences is subject to downdrift in a number of languages, for example Igbo, Hausa and Twi, etc. This phenomenon, representing an automatic lowering process, applies progressively to each H preceded by a L. A sequence of H-L-H is not realised as [  $\text{---} \text{---} \text{---}$  ], but rather as [  $\text{---} \text{---} \text{---}$  ]. This contrasts with the phenomenon in the identical tonal sequences in most African languages. For instance, a sequence of H tones is realised as [  $\text{---} \text{---} \text{---}$  ] rather than as [  $\text{---} \text{---} \text{---}$  ] (p.228). On the other hand, downstep can be predicted morphophonemically in many cases, "in which a lowered H receives phonemic status when a L which 'conditions' downdrift is lost (either through deletion or through assimilation)" (p.227). A standard example is cited in Twi (Fromkin 1972: 57): the realisation of /mí ɔ bú/ (my stone) (H-L-H) is /mí<sup>1</sup> bú<sup>1</sup>/. By downdrift, the second H is lowered. At this point, the L /ɔ/ is deleted and the result is H<sup>1</sup>H. That is, a H followed by downstepped<sup>1</sup>H, which is contrasted with H-H and H-L. Downstep and downdrift are phonologically or morphophonemically predictable. Pierrehumbert (1980) adopts the term 'downstep' traditionally used in African studies in her description of the intonation pattern of English: any bitonal accent (indicated by a plus sign), H\*+L, H+L\*, L+H\* and L\*+H (the asterisk mark is associated with a stressed syllable), triggers the lowering of the pitch of the following H (p. 152). English downstep is conditioned by the morphological organisation of the intonation; it takes place in sequences of the form H+L and L+H with a H, but not in other alternation tonal sequences (p.150). Examples are given in the utterance 'an orange ballgown' with (a) H\*H\*LL% - standard declarative intonation; (b) H\*+L H\*L L% - a downstepping accent on orange; (c) L\*H\*LL% - surprise-redundancy contour (Beckman and Pierrehumbert 1986: 257). Downstep only occurs in example (b) where the bitonal H\*+L causes the following H\* to have a lower  $F_0$  value than the preceding H\*. However, declination in Cantonese is not triggered by any phonological sequence of tones nor determined by any linguistic factors. It is an automatic lowering process present all the time during the course of speech and applies to all tonal sequences. The 'lowering' is based on the comparison between the  $F_0$  values of identical tones or similar tones within the intonation group in question.

Phonologically equivalent tones decrease their phonetic values when they appear later in the same intonation group. Take Example 1 below: the fitted lines linking up the phonologically identical tones take a parallel downward slope, i.e., the tonal peak of the second T1 (158Hz) is lower than that of the first T1 (169Hz) and the lowest point of the first T6 (127Hz) is higher than that of the second T6 (92Hz). There are two T4s and two T6s in Example 2. The  $F_0$  value is 96Hz at the lowest point of the first T4 and 90Hz at the lowest point of the second T4; and

\* This paper is a modified version of part of my Ph.D thesis, which has recently been published in book form by Lincom Europa, Muenchen.

<sup>1</sup> An intonation group is defined as the smallest chunk marked off by resetting the pitch span in the melody of a stream of speech.

1411Hz at the mid point of the first T6 and 124Hz at the mid point of the second. The identical tones have no identical  $F_0$  value in the same intonation group; the later a tone occurs, the lower its  $F_0$  value. The fitted lines of the pitch span linking up the identical tones descend gradually as shown in Figure 1.

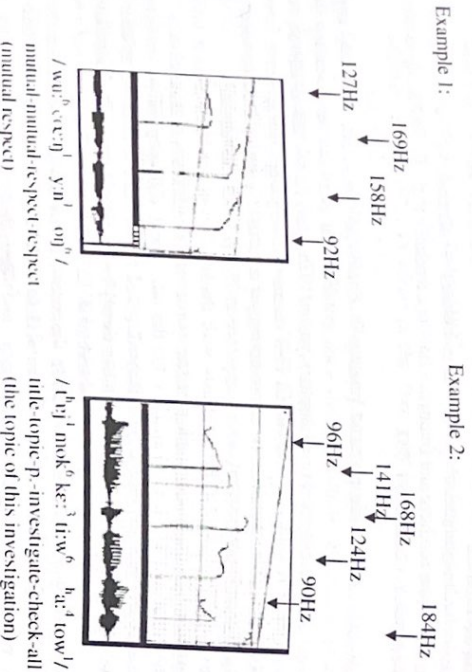
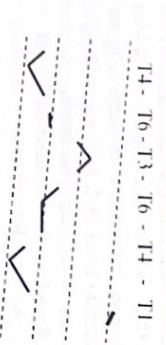


Fig. 1. The tonal contrast in an intonation group represented by fitted lines, taken from example 2 above.



The downward trend of the fitted lines representing the pitch span of the intonation group is a matter of fact, present in all intonation groups. It can easily be discerned by visual inspection. If a rising slope occurs, it perhaps indicates that the  $F_0$  maximum is located on a high tone, T1, which is at the end of the slope of the contour as in Example 2, but it does not indicate the absence of declination. We argue that the slope line which is formed by successive single phonological tonal contours is the intonation contour, and this is also Chao's proposal in the intonation of Mandarin ("normal intonation is simply a succession of the tones" 1968: 41). If there are three identical/similar tones in an intonation group, the identical tones A, B and C are linked up by a fitted line, where B is lower than A and C is lower than B.

We are not sure about the cause of the declination. The presence of declination in every single intonation group in our data strongly supports the view that it is an automatic process – it is due to interaction between the larynx and the respiratory system (Lieberman 1967, Collier 1975 and 1983). The physiological explanation suggests that the drop in  $F_0$  is a result of the

natural falling off in subglottal pressure that accompanies expiration in speech. Subglottal pressure and laryngeal tension are the principal components of output  $F_0$ . Obviously, speakers can control the resetting of the pitch if they want to, as they can raise their voice or adjust which phonological tone they want to produce. Speakers can also control the falling or rising of tonal movement as they wish, as when they produce a falling tone or a rising tone. Speakers can also drop their voice at the end of an utterance as if they have lost interest. However, speakers do not seem to be able to control the declination.

## 2 Identical tonal sequences

Although all our data (as in the examples used in this paper, which were taken from a recorded natural conversation between three young professional commentators from a radio programme in Hong Kong) clearly show that the phenomenon of declination exists in all intonation groups which consist of a variety of tonal combinations, a small experiment was conducted to strengthen the argument. The experiment was designed to investigate whether declination exists in identical-tonal utterances. Each tone was placed in three utterances of different length, each utterance consisting of four to eleven syllables. Details of the utterance data can be found in the appendix. Two native speakers of Hong Kong Cantonese, JHDG and LTHJ (male postgraduates) read the designed utterances with three repetitions, in a sound-proofed booth at SOAS. The technique used to record fundamental frequency was electro-laryngography.

The laryngograph is a device enabling the vocal fold contact area to be investigated non-invasively (Foucain *et al.* 1971: 172). Two electrodes, with the help of a bondage wrapping on the neck, are placed on both sides externally at the level of the larynx. When the vocal folds vibrate, the current flow passing between the electrodes changes. With no vocal fold contact, the current flow between the electrodes is at the minimum, with full vocal fold closure, the current flow is at the maximum. The output of this changing current flow which passes between the electrodes is called the laryngograph waveform (Lx). The Lx waveform, instantaneous fundamental frequency contour (Fx) and spectrograms can be derived from the laryngograph trace and displayed simultaneously in the PCLX SPG software package. The package provides the optimum display for clarity of measurement. All tokens were digitised at a 10 kHz sampling rate. The informants were free to choose where to define the intonation groups. Measurements of the  $F_0$  values were taken only from the centre point of T1, T3 and T6, and the valley of T4. The two rising tones, T2 and T5, were measured at two points: the peak and the valley. Both time and the  $F_0$  data are normalised. The results strongly support the claim made above: declination exists everywhere in Cantonese (as displayed in figures 2-7).

Fig. 2. Mean  $F_0$  contours of T1 occurring consecutively showing the pitch of identical tones descending gradually.

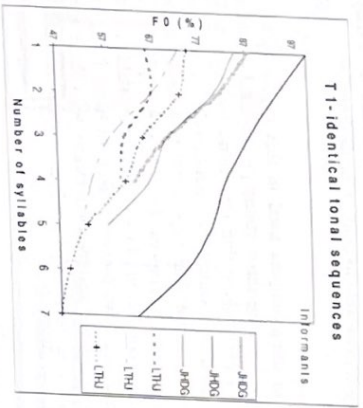


Fig. 3. Mean  $F_0$  contours of T3 occurring consecutively showing the pitch of identical tones descending gradually.

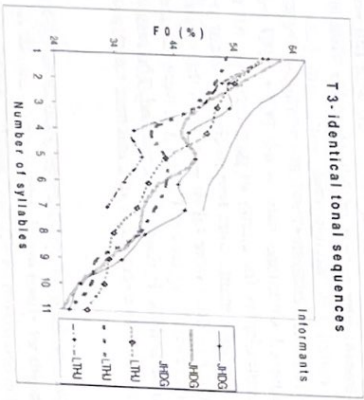


Fig. 4. Mean  $F_0$  contours of T4 occurring consecutively showing the pitch of identical tones descending gradually.

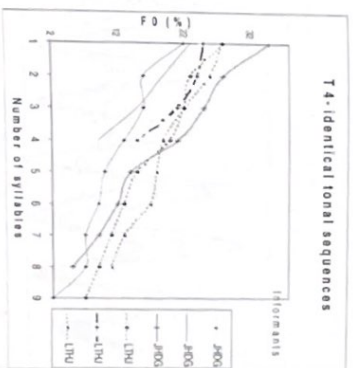


Fig. 5. Mean  $F_0$  contours of T6 occurring consecutively showing the pitch of identical tones descending gradually.

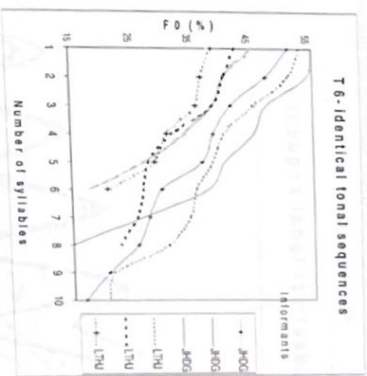


Fig. 6. Mean  $F_0$  contours of T2 occurring consecutively showing the pitch of identical tones descending gradually.

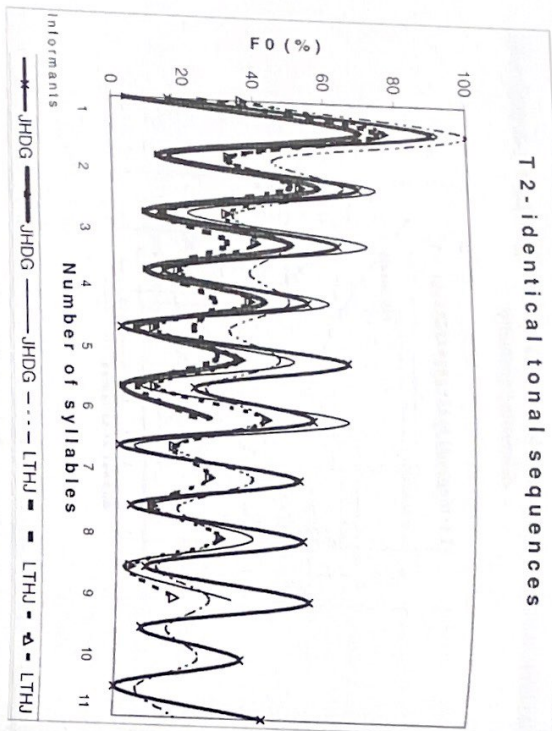
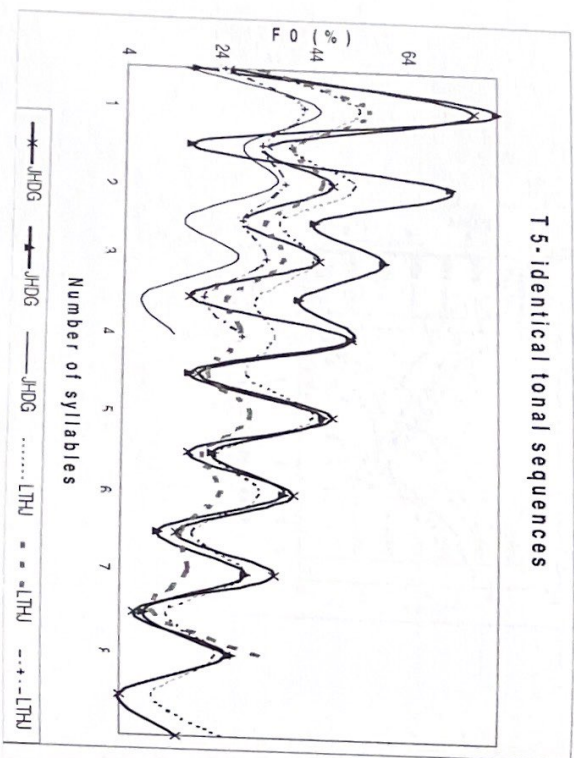


Fig. 7. Mean  $F_0$  contours of T5 occurring consecutively showing the pitch of identical tones descending gradually.

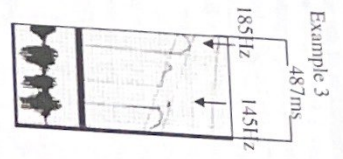


### 3 Long and short intonation group

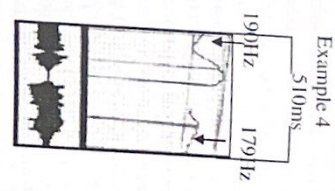
It is said that in longer utterances a slower declination rate is found invariably (Maceda 1976, quoted by Ladd 1984: 57). Hertz (1990: 245) suggests that in Bambara, a two-tone language, the starting and ending frequencies of the baseline are relatively independent of the sentence duration, while the starting and ending frequencies of the topline are a function of sentence duration. Lantian (1993: 203) presents evidence that declination in Yoruba is dependent on tone type: L tones have the steepest slopes and H tones the shallowest. On the other hand, it is reported that "calculation of the exact rate of declination is a difficult task" (Vaisseire 1983: 56). Not only can the general tendency of declination of an intonation group be easily detected by the eye, but a steep declination line can also be easily distinguished from a gentle declination line by visual inspection. Certainly it is difficult to find a long intonation group with a very steep slope, but it is not uncommon for short intonation groups to be presented with a steep slope. Data shown in this study clearly indicate that the slope of the declination line is not simply decided by the length of the intonation group. Here, we present two pairs of examples. Examples 3 and 4 are short – 487ms ~ 510ms respectively; examples 5 and 6 are long – 1187ms ~ 1193ms respectively. Examples 3 and 4 both consist of four syllables, whereas Examples 5 and 6 both consist of seven syllables. The different slope of the declination line in each pair can be easily caught by the eye in terms of relative gentleness or steepness.

Steep decline vs. Slow decline

Short intonation groups:

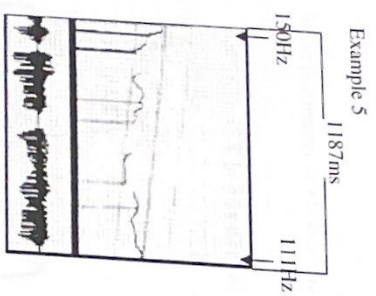


/kɚm<sup>2</sup> k<sup>h</sup>ɔy<sup>5</sup> tɪ:m<sup>2</sup> a:<sup>2</sup>/  
 in that case-he-how-p.  
 (So, what will he do then?)

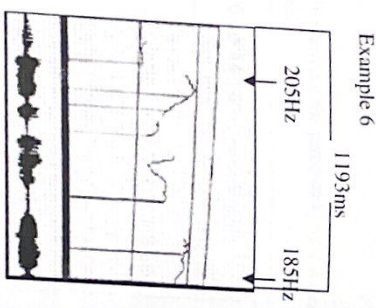


/nɔw<sup>5</sup> tɪk<sup>1</sup> kɔw<sup>3</sup> lɔ:<sup>2</sup>/  
 have not-able-teach-p.  
 (unteachable)

Long intonation groups:



/mɪ<sup>1</sup> kɔ:<sup>3</sup> kɔw<sup>3</sup> jɔk<sup>6</sup> p<sup>h</sup>ɔŋ<sup>4</sup> jɪ:<sup>5</sup> wɔŋ<sup>2</sup>/  
 this-m-learn-cultivate-assess-discuss-committee  
 (the Body of Educational Assessment)



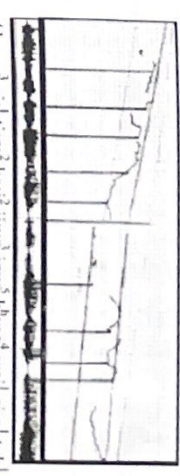
/jɪ:<sup>4</sup> kɔ:<sup>1</sup> ŋɔ:<sup>5</sup> tɛj<sup>6</sup> kɔw<sup>3</sup> cɪ:<sup>1</sup> nɛ:<sup>2</sup>/  
 now(2)-1-pl-learn-expert-p.  
 (nowadays us teachers)

\* The peak F<sub>0</sub> values of T1 and T2 are very close, as are the F<sub>0</sub> values in the centre points of T3 and T5.

We have made no attempt to calculate the declination rate in each intonation group. The slope of the declination line seems to be affected by many factors, for example, the length of the intonation group, the position of the intonation group in the whole utterance, the type of sentence (command, request, etc), the tempo, etc.

4 Declaratives and interrogatives

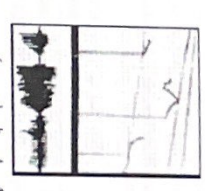
It is reported that in a number of languages declination can be suppressed in making interrogatives (Vaisseire 1983: 57), and questions requiring answers other than 'yes' or 'no' may even form a rising tone in Chengdu (Chang 1958: 78). Lindau (1985: 37) experiments with yes-no questions and question-word questions in Hausa, and reports that "all questions are specified with zero slope" (1985: 37). However, as with the declaratives, the interrogatives in our data all manifest declination. Here, we present examples of 'wh'-interrogatives which contain a question indicator 'why' (tɪ:m<sup>2</sup> kɔj<sup>2</sup>) or 'how' (tɪ:m<sup>2</sup>) followed by either of the final-particles /ka:<sup>2</sup>/ or /a:<sup>2</sup>/:



/kɔw<sup>3</sup> cɪ:<sup>1</sup> tɪ:m<sup>2</sup> kɔj<sup>2</sup> jɪ:w<sup>3</sup> jɔw<sup>3</sup> k<sup>h</sup>ɪn<sup>1</sup> wɛj<sup>1</sup> cɪ:n<sup>1</sup> tɪk<sup>1</sup> kɔ:<sup>2</sup>/  
 teach-expert-how-explain-need-have-power-might-until-o.k-p.  
 (Why do teachers need to have authority anyway?)

Example 8  
 /kɚm<sup>2</sup> k<sup>h</sup>ɔy<sup>5</sup> tɪ:m<sup>2</sup> a:<sup>3</sup>/ [please refer to the figure in Example 3 above]  
 in that case-he-how-p.  
 (So, what will he do then?)

One can argue that it is common for an interrogative to display a falling trend if it contains a question word (i.e., a 'wh' word), as in English. The following example is a rhetorical interrogative without a question word but with a final-particle /a:<sup>2</sup>/. It also displays the phenomenon of declination:



/ ɔw<sup>6</sup> kɔj<sup>1</sup> t<sup>h</sup>ɔŋ<sup>4</sup> a:<sup>2</sup>/  
 to be-street-child-p.  
 (He'll be out on the streets?)

### 5 Yes/no and echo questions

The following is a constructed yes/no question consisting of a string of T4s. Yes/no questions in Cantonese are choice type questions, giving a choice of 'yes' or 'not yes'. A final particle (*la?*) is often attached at the end of the utterance but is not obligatory. The invented utterance employs T4 only for the sake of using identical tones with the negation */m<sup>4</sup>/*. No final particle is used; this also allows us to avoid distorting an identical tone sequence. Two informants (JHDG and LTHJ) read out the yes/no questions and their corresponding answers which are illustrated below in figures 8a and 8b, respectively.

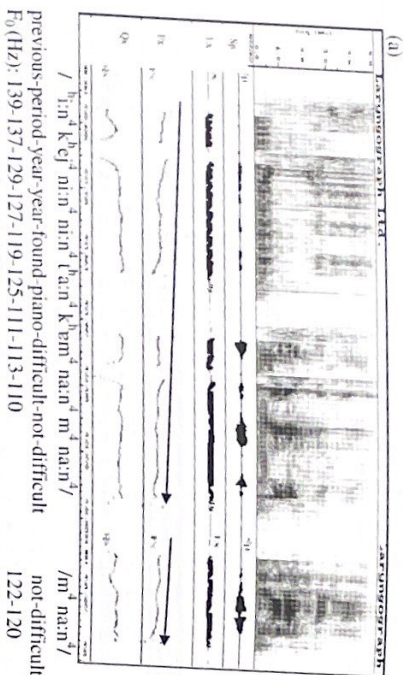


Fig. 8. Extracted F<sub>0</sub> contours (F<sub>x</sub>) of the question and answer ('Did you find it difficult to play the piano at the previous stage?' - 'No.'). spoken by JHDG for (a) and LTHJ for (b). The arrows indicate the declining F<sub>0</sub> over the utterance. The F<sub>0</sub> values are taken from the valley of the tones.

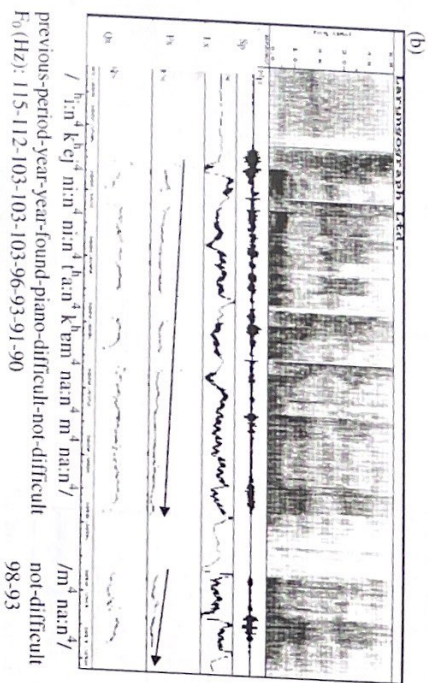


Fig. 9. Extracted F<sub>0</sub> contours (F<sub>x</sub>) of a Yes/No interrogative and an echo interrogative respectively, spoken by JCCF.

The downward trend line in these questions and answers is easily detected. In the utterance spoken by JHDG, there is a 29Hz drop from the beginning to the end of the question and only a 2Hz drop in the answer; in the utterance spoken by LTHJ, there is a 25Hz drop in the question and a 5Hz drop in the answer. This evidence runs counter to the view that declination is suppressed in interrogatives. It supports our claim that declination operates in both declaratives and interrogatives in Cantonese.

However, it is often said that a declarative can be turned into a question simply by using a rising pitch, for example, when the sentence is spoken in doubt or suspicion. According to this view, no final particle is used to indicate an interrogative, but rather the distinction between an interrogative and a declarative is totally dependent on the tonal contour, i.e., one is rising and the other is falling (e.g., Kwok 1984). This view would also imply that declination may be absent in this type of interrogative. It would lead one to expect that declination in Cantonese is not an automatic phonetic property but depends on a linguistic choice between the different linguistic functions (i.e., interrogative and declarative). In order to investigate whether declination is present in interrogatives which are heard to be rising, we constructed a pair of utterances and had informant JCCF read them out. The result is displayed in figure 9. Each one of the pair of utterances consists of identical words, but one is expected to be falling and one is expected to be rising. The utterances consist of phonologically equivalent tones and no other tones interfere.

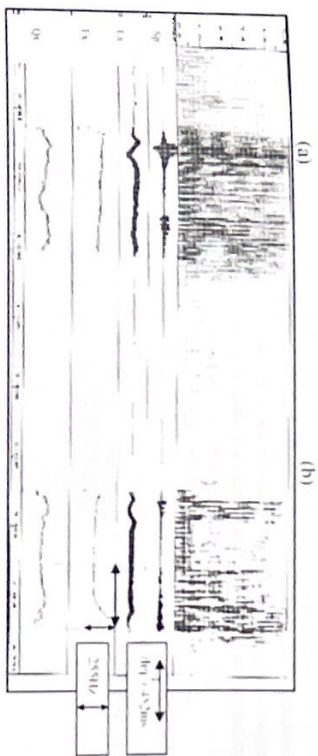


Fig. 9. Extracted F<sub>0</sub> contours (F<sub>x</sub>) of a Yes/No interrogative and an echo interrogative respectively, spoken by JCCF.

The words of each of the two utterances in (9) are /ɪn<sup>4</sup> k'ɛj<sup>4</sup> m'ɛj<sup>4</sup> (come-not-come) which is interpreted as 'Are you coming?' for (a) and 'Did you ask me if I am coming or not?' for (b). In (b), the horizontal double-headed arrow indicates the duration of the last syllable (452ms) and the vertical double-headed arrows indicate a rise of 255Hz from the valley to the peak of the syllable. The vertical lines mark the boundaries of the last syllable.

Downward trend in F<sub>0</sub> contours is clearly displayed in different length and different types of utterances in figures 2-7. The F<sub>0</sub> contours of yes/no interrogatives in figures 8a-b and 9a read out by different speakers display a uniform downward trend. The downward line in figure 9b demonstrates that declination is also present in an echo interrogative consisting of three identical tones which is normally expected to be rising. The visible declining trend starts at the beginning of the utterance and ends in the middle portion of the last syllable before the rising tail. A rising contour can be present but it is a local event affecting only the last syllable of the utterance. This finding sustains Fok's claim. Fok (1974) conducted an experiment using one word interrogative sentences and claimed that all tones end with a rising tail, and end at

about the same frequency region – they become less distinct; however, they still “maintain their initial frequency distinction”. “The starting frequency of T1 is the highest, then comes T3 followed by T2, T4, T5 and T6” (p.29). We are not sure whether her term ‘initial frequency’ is the same thing as the ‘starting frequency’ or whether it refers to the frequency at a certain length of time from the starting point. By examining the figures she offers, we can see that the pattern of relationships among the tones maintains the contrast in the first half (or less than three quarters) of the tonal duration. If this observation is valid, her term ‘rising tail’ makes sense: the tail is the last half (or slightly more than one quarter) of the tonal duration. She conducted another experiment by putting the test word in the penultimate syllable of an invented sentence. She claims that “[t]he tones said in isolation all give an upward turn as the rising intonation in this case can be passed on to nothing else. Tones extracted from sentences conform more to their basic structure as the rising tail is shifted to the last word” (p.31). In our view, a syllable tone expressing query, doubt or suspicion ending with a rising tail does not necessarily induce a ‘rising intonation’ in the system of Cantonese intonation. A rising tone is proposed by some researchers in some East Asian tone languages: Chang (1958) for Chengdu Chinese, Ho (1977) for Mandarin, Luksameyanawin (1983) for Thai, and Dung *et al* (1998) for Vietnamese. Chang, Ho and Dung’s rising tone is realised as the perturbation of the final syllable, Luksameyanawin’s Tone 2 (rising tone) affects the rising pitch contour of the tonic syllable, and the tonic syllable is usually located at the end of a tone group. If we are not mistaken, the rising intonation contour in those languages suggests that almost nothing happens until the final syllable. Certainly, the final tone of an utterance can be modified in various ways. A rising tail attaching to the end of some forms of interrogatives is probably not enough to justify the conclusion that there is a rising tone in Cantonese or that declination is suppressed in interrogatives in Cantonese. Our data show that the rising tail with various modifications occurs on the last syllable of utterances. Apart from signalling some forms of interrogatives (e.g., echo interrogatives as in figure 9b), it can also signal declaratives with other attitudes, such as irony or impatience, etc. We shall demonstrate this in the following section.

**6 Rising tail**

Here, we present examples of declaratives with different attitudes: confirmative, ironic and impatient confirmation in figures 10, 11 and 12, respectively (spoken by JHDG).

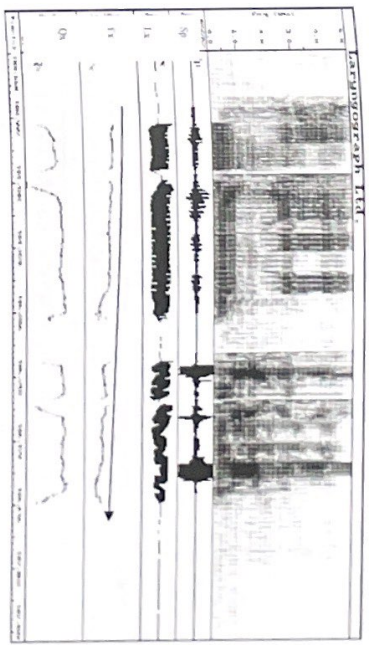


Fig 10 Extracted F<sub>0</sub> contours (F<sub>x</sub>) of a confirmative declarative ‘nan’<sup>4</sup> / previous-period-year-bound-piano-not-difficult-. It was not difficult to play the piano in the previous stage’, spoken by JHDG. The arrow indicates the declining trend of the F<sub>0</sub> contour.

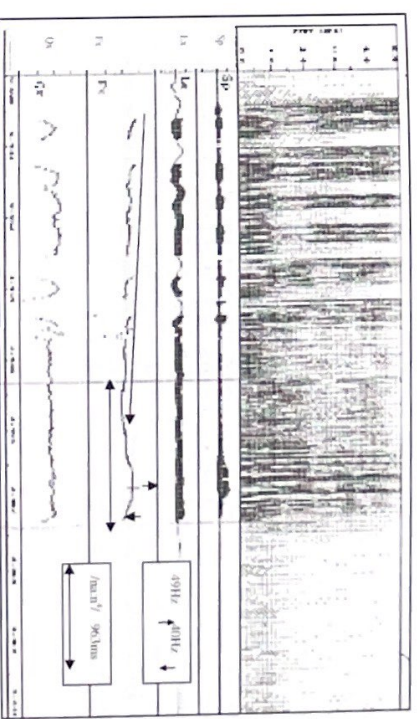
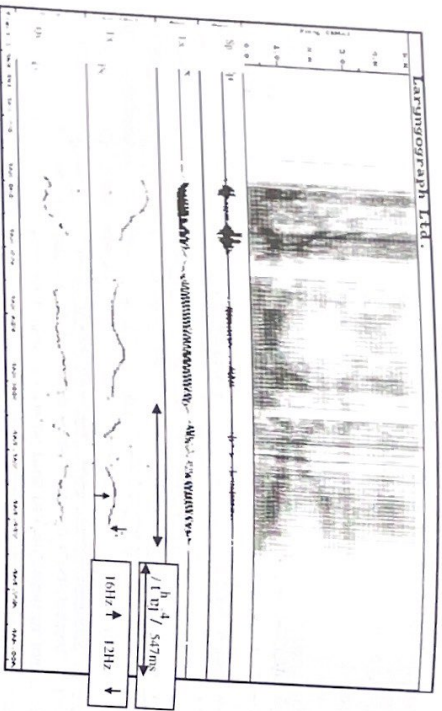


Fig. 11. Extracted F<sub>0</sub> contours (F<sub>x</sub>) of a declarative, consisting of the same words as in figure 10 but with an ironic expression, spoken by JHDG. The arrow indicates the declining trend of the F<sub>0</sub> contour. The horizontal double-headed arrow indicates the duration of the last syllable. The upward arrows indicate the rise from the valley to the peak of the syllable, and the downward arrows indicate the fall from the peak to the offset of the syllable. The two vertical lines mark the boundaries of the last syllable.

Fig. 12. Extracted  $F_0$  contours (F<sub>0</sub>) of a declarative with impatient confirmation 'Ken<sup>1</sup> jet<sup>6</sup> mow<sup>5</sup> man<sup>6</sup> he<sup>2</sup> / (to-day-not-task-topic - there is no problem today)', spoken by JHDG. The horizontal double-headed arrow indicates the length of the final syllable. The upward arrows indicate the rising peak from the valley of the syllable, and the downward arrows indicate the fall from the peak of the syllable.



The rising slope of the last syllable in the impatient confirmative declarative in figure 12 is not as marked as that in the ironic expression in figure 11. The rise soars by 49Hz in figure 11, but only to 161Hz in figure 12. Besides, the noticeable difference between the two in the amount of the rise, there is also a difference in duration which, if anything, attracts even more attention: the mean duration of the preceding syllables is similar (269ms for figure 11 and 261ms for figure 12), but the final syllable in figure 11 is more than double that in figure 12 (963ms for the former and 547ms for the latter). The duration of the last syllable in figure 11 (963ms) is nearly four times the mean duration (269ms) of its preceding syllables, whereas the duration of the last syllable in figure 12 (547ms) is about double the mean duration (261ms) of its preceding syllables. The amount of the lengthening is much smaller for figure 12.

As for the declaratives with ironic and impatient confirmation, shown in figures 11 and 12 respectively, the last syllable T4 displays a rise after the canonical fall, followed by another fall. Comparing this rise with that in the echo interrogative (in figure 9b), the difference in placement of the rising peak is obvious – the rising in declaratives is near the centre between the onset and the offset of the vocalic portion, whereas the rising peak is at the offset for the echo interrogative.

The greatly lengthened final syllables in the examples above play a tonic prominence role; they modify their tonal contour by attaching a sharp rising tail, or a gentle rise followed by a gentle fall, etc. They use a great amount of prolongation, different  $F_0$  peak placements and various pitch modifications in the last half of the duration of the tonal contour to convey various linguistic and paralinguistic meaning, for example, to indicate echo interrogatives, ironic declaratives and impatient declaratives etc. (We make this claim tentatively, conscious that a larger experiment would need to be conducted before it could be sustained.)

Any pitch modification in the final syllable is treated as a local event which does not contaminate the downward trend of the whole utterance. We have not found that declination suffers on account of different linguistic functions (e.g. declaratives vs. interrogatives) or different paralinguistic functions (e.g. ironic, impatient, surprised or suspicious, etc).

## 7 Conclusion

The downward slope present in all utterances, whatever their combination of tonal sequences, clearly indicates that declination is a phonetic property of utterances. The presence of declination does not signal any grammatical or paralinguistic functions. The declination lines operate within an intonation group and determine that phonologically identical tones decrease their phonetic pitch value going from left to right. A rising tail can occur at the last syllable of an utterance to signal grammatical or paralinguistic meaning, but this does not affect the declining trend of the whole utterance and is considered to be a local event.

\* In an intonation group, there may be a single piece of information or several pieces of information, one of which is the most important and is then realised as predominant in the intonation group. The predominant piece in an intonation group is the tonic. This is adapted from Halliday (1967, 1970).



## Appendix: List of utterances consisting of identical tonal sequences

- T1: 1. / y<sup>21</sup> fe<sup>1</sup> ho<sup>1</sup> t<sup>1</sup> n<sup>1</sup> /  
pig-fly-punch-sky  
(Pigs fly sharply to the sky.)
2. / hɔ:ɿ<sup>1</sup> ɬe:ŋ<sup>1</sup> fa: ho:ɿ<sup>1</sup> he:ɿ<sup>1</sup> /  
open-window-flower-open-fragrant  
(Once the window is open, you can smell the fragrance from the flowers.)
3. / ɬa<sup>1</sup> t<sup>1</sup> n<sup>1</sup> toŋ<sup>1</sup> toŋ<sup>1</sup> ɬe<sup>1</sup> y<sup>21</sup> kɔ:ŋ<sup>1</sup> /  
spring-sky-east-wind-blow-pearl-river  
(In Spring, the wind blows to the River Pearl from the east.)
- T2: 4. / ɦi<sup>1</sup> n<sup>1</sup> ka:ɿ<sup>1</sup> po<sup>2</sup> cw<sup>2</sup> tɔ:ŋ<sup>1</sup> ɦɿ<sup>2</sup> ca:ŋ<sup>1</sup> kɔ:ŋ<sup>1</sup> ɬe:ɿ<sup>1</sup> he:ɿ<sup>1</sup> ho<sup>2</sup> /  
how-explain-protect defend-party-at-province-harbour-in-reflect-sound-good  
(Why do the Conservative Party have a good influence in the Province and Harbour?)
5. / ka:ɿ<sup>2</sup> ka:ɿ<sup>2</sup> ha:ɿ<sup>2</sup> ho<sup>2</sup> ho<sup>2</sup> t<sup>1</sup> ɬɿ<sup>2</sup> /  
sit-sit-a bit-very-good-look  
(It is fun to make trouble.)
6. / ɦɿ<sup>2</sup> kw<sup>2</sup> ɦw<sup>2</sup> ɦɿ<sup>2</sup> n<sup>2</sup> w<sup>2</sup> kɔ:ŋ<sup>1</sup> ke:ɿ<sup>2</sup> ho<sup>2</sup> ce:ŋ<sup>2</sup> /  
at-nine-floor-drink-wine-talk-chat-very-smart  
(It is very smart to have a chat and a drink on the ninth floor.)
- T3: 7. / ɦɔ:ɿ<sup>1</sup> ka:ɿ<sup>1</sup> fa:ɿ<sup>1</sup> ɬe:ɿ<sup>1</sup> ke:ɿ<sup>1</sup> ce:ŋ<sup>1</sup> coŋ<sup>1</sup> tɔ:ɿ<sup>1</sup> ɦe:ɿ<sup>1</sup> fa:ɿ<sup>1</sup> k<sup>2</sup> ɔ:k<sup>1</sup> /  
relief/leave-quick-fun-knot-account-deliver-goods-go-France-nation  
(Quickly go to settle the account and deliver the goods to France.)
8. / ce:ɿ<sup>1</sup> kɔ:ɿ<sup>1</sup> k<sup>2</sup> ɔ:ɿ<sup>1</sup> ha:k<sup>1</sup> ha:k<sup>1</sup> he:ɿ<sup>1</sup> he:ɿ<sup>1</sup> kw<sup>2</sup> ca:ɿ<sup>1</sup> k<sup>2</sup> ɔ:ɿ<sup>1</sup> /  
four-in-strange-guest-guest-guest-air-enough-all-strange  
(The four strange guests standing on ceremony are strange enough.)
9. / kɔ:ɿ<sup>2</sup> po<sup>2</sup> ko<sup>2</sup> ɦe:ɿ<sup>2</sup> k<sup>1</sup> n<sup>1</sup> eŋ<sup>1</sup> k<sup>2</sup> ɔ:k<sup>1</sup> /  
n-report-report-idea-see-right-right  
(The opinion in the report is correct.)
- T4: 10. / ɦa:ɿ<sup>1</sup> k<sup>2</sup> e:ɿ<sup>1</sup> n<sup>1</sup> n<sup>1</sup> ɦa:ɿ<sup>1</sup> k<sup>2</sup> n<sup>1</sup> n<sup>1</sup> n<sup>1</sup> n<sup>1</sup> n<sup>1</sup> n<sup>1</sup> /  
previews-period-the-piano-difficult-not-difficult  
(Was it difficult to play piano at the previous stage?)
11. / wɔ:ɿ<sup>1</sup> ɦɔ:ɿ<sup>1</sup> ce:ŋ<sup>1</sup> ɦw<sup>2</sup> ɦw<sup>2</sup> ɦw<sup>2</sup> ɦw<sup>2</sup> ce:ɿ<sup>1</sup> k<sup>2</sup> w<sup>2</sup> t<sup>1</sup> /  
yellow-river-long-flow-cow-sheep-accumulate-group  
(The Yellow River flows forever and there are lots of cattle and sheep.)
12. / ɦɿ<sup>2</sup> n<sup>2</sup> m<sup>2</sup> ce:ɿ<sup>2</sup> ɦɿ<sup>2</sup> /  
human-not-turn into-human  
(Human not appearing human.)
- T5: 13. / me:ɿ<sup>1</sup> fa:ɿ<sup>1</sup> ne:ɿ<sup>1</sup> ma:ɿ<sup>1</sup> ma:ɿ<sup>1</sup> m<sup>1</sup> n<sup>1</sup> k<sup>2</sup> ce:ɿ<sup>1</sup> ɬe:ɿ<sup>1</sup> ɬe:ɿ<sup>1</sup> ɦa:ɿ<sup>1</sup> /  
beautiful-woman-lady-evening-evening-reluctant-force-sit-a bit  
(The beautiful woman sits reluctantly for a while every evening.)
14. / ɦw<sup>2</sup> ɦw<sup>2</sup> ma:ɿ<sup>1</sup> ɦe:ɿ<sup>2</sup> we:ɿ<sup>1</sup> ɦɿ<sup>2</sup> n<sup>1</sup> ɦw<sup>2</sup> ɦe:ɿ<sup>2</sup> /  
old-friend-buy-thing-ever-long-have-polite  
(The old friend who comes to shop is always polite.)
15. / ɦɿ<sup>2</sup> ɬe:ɿ<sup>2</sup> mo<sup>2</sup> ɦe:ɿ<sup>2</sup> ke:ɿ<sup>2</sup> /  
I-not-pay attention him  
(I ignore him.)
- T6: 16. / ɦɔ:ɿ<sup>1</sup> k<sup>2</sup> ɦa:ɿ<sup>1</sup> t<sup>1</sup> n<sup>1</sup> ce:ɿ<sup>1</sup> w<sup>1</sup> t<sup>1</sup> toŋ<sup>1</sup> ta:ɿ<sup>1</sup> lek<sup>2</sup> ɦe:ɿ<sup>2</sup> pe:ɿ<sup>2</sup> /  
study-school-electric-watch-active-move-big-strength-prepare-prepare  
(Prepare well for the television activity in school.)
17. / ta:ɿ<sup>1</sup> ɦɿ<sup>2</sup> ha:ɿ<sup>2</sup> pi:ɿ<sup>1</sup> me:ɿ<sup>1</sup> ɦa:ɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> pa:ɿ<sup>1</sup> ce:ɿ<sup>2</sup> /  
but-is-below-side-not-to the best-strength-work-thing  
(But the people at the lower level do not do their best in the work.)
18. / ɦɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> ɦe:ɿ<sup>2</sup> ce:ɿ<sup>2</sup> /  
the-second-day-do bad-thing  
(Committing an offence on the next day.)

## References

- Chang, Nienehuang (1958). Tones and intonation in the Chengdu Dialect. *Phonetica* 2:59-84.
- Chao, Yuanren (1968). *A grammar of spoken Chinese*. (1985 3rd edn) University of California Press.
- Collier, René (1975). Physiological correlates of intonation patterns. *Journal of Acoustical Society of America* 58: 249-255.
- Broecke (eds.) *Abstracts of the 10th International Congress of Phonetic Sciences*: 440. Dordrecht: Foris.
- Dung Dothe, Thienhuong Tran & Georges Boulakia (1998). Intonation in Vietnamese. In *Intonation Systems*: 395-416. Ed. by Hirst, D and A. di Cristo, Cambridge University Press.
- Fok, C. Y.-Y. (1974). *A perceptual study of tones in Cantonese*. University of Hong Kong.
- Fourin A J & Erm Abberton (1971). First applications of a new laryngograph. *Medical and Biological Illustrated* 21: 172-182.
- Fromkin, Virginia (1972). Tone feature and tone rules. *Studies in African Linguistics* 3:47-76.
- Halliday, M A K (1967). *Intonation and grammar in British English*. Mouton.
- Hertz, Susan R (1990). The delta programming language. In *Papers in Laboratory Phonology 1*. Ed. by Kingston, J and M Beckman, Cambridge University Press.
- Ho, Aichen T (1977). Intonation variation in a Mandarin sentence for three expressions: interrogative, exclamatory and declarative. *Phonetica* 34: 446-457.
- Hymun, Larry (1975). *Phonology: theory and analysis*. Holt, Rinehart & Winston.
- Kwok, C H L (1984). *Sentence particles in Cantonese*. University of Hong Kong.
- Ladd, Robert D (1984). Declination: a review and some hypotheses. *Phonology Yearbook* 1:53-74.
- Laniran, Yetunde Olabisi (1993). *Intonation in tone language: the phonetic implementation of tones in Yoruba*. Cornell University, Ithaca.
- Lieberman, P (1967). *Intonation, perception and language*. Cambridge, MA: MIT Press.
- Lindau, Mona (1985). Testing a model of intonation in a tone language. *UCLA Working Papers in Phonetics* 61: 26-39.
- Luksaneeyanawin, S (1983). *Intonation in Thai*. Ph.D thesis, University of Edinburgh.
- Maeda, Shinji (1976). *A characterization of American English intonation*. Ph.D Thesis, MIT.
- Pietruchhert, J (1980). *The phonology and phonetics of English intonation*. Ph.D thesis, MIT.
- Pietruchhert, J & M Beckman (1986). *Japanese tone structure*. The MIT Press.
- Vaisse, J (1983). Language-Independent Prosodic Features. In *Prosody: Models and Measurements*: 53-66. Ed. by Cutler A and D B Ladd, Springer-Verlag Berlin Heidelberg.