WORKING PAPERS

IN

LINGUISTICS

The notes and articles in this series are progress reports on work being carried on by students and faculty in the Department. Because these papers are not finished products, readers are asked not to cite from them without noting their preliminary nature. The authors welcome any comments and suggestions that readers might offer.

Volume 41(3)

2010
(April)

DEPARTMENT OF LINGUISTICS
UNIVERSITY OF HAWAIʻI AT MĀNOA
HONOLULU 96822

DEPARTMENT OF LINGUISTICS FACULTY

2010

Victoria B. Anderson
Byron W. Bender (Emeritus)
Benjamin Bergen
Derek Bickerton (Emeritus)
Robert A. Blust
Robert L. Cheng (Adjunct)
Kenneth W. Cook (Adjunct)
Kamil Deen
Patricia J. Donegan (Co-Graduate Chair)
Katie K. Drager
Emanuel J. Drechsel (Adjunct)
Michael L. Forman (Emeritus)
George W. Grace (Emeritus)
John H. Haig (Adjunct)
Roderick A. Jacobs (Emeritus)
Paul Lassettre
P. Gregory Lee
Patricia A. Lee
Howard P. McKaughan (Emeritus)
William O'Grady (Chair)
Yuko Otsuka
Ann Marie Peters (Emeritus, Co-Graduate Chair)
Kenneth L. Rehg
Lawrence A. Reid (Emeritus)
Amy J. Schafer
Albert J. Schütz, (Emeritus, Editor)
Ho Min Sohn (Adjunct)
Nicholas Thieberger
Laurence C. Thompson (Emeritus)

TONE-MELODY RELATIONSHIP IN CANTONESE

ELAINE LAU

Cantonese lyrics are found to adhere to the pitch contours and relative pitch heights of the tones, in order to preserve in the lyrics the tonal values of the words.

A series of meta-analyses over a selection of Cantonese children's songs was performed; it investigated (i) the distribution of lexical tones in correlation with musical melody; (ii) the relationship between tonal pitch and melody; and (iii) how contour tones are dealt with in mapping lyrics with music.

This study showed that the writing of lyrics in tonal languages is not as free as in non-tonal languages, and takes into account the lexical tones, in order to preserve the tonal distinctions between words.

1. INTRODUCTION. Cantonese is a tonal language, which means that pitch is used as a distinct phonetic feature to contrast word meaning. The Cantonese tone system is considerably more complex than that of Mandarin Chinese. Depending on how the system is analyzed, the exact number of tones there are in Cantonese varies. Traditional classifications have stated that there are nine distinct tones in Cantonese, including the tones on checked syllables, i.e., syllables ending in unreleased stops /p/, /t/, /k/. Only six tones are clearly distinct in Cantonese, and the tones on checked syllables are seen as abbreviated counterparts of the three level tones. Table 1 illustrates the tone system in Cantonese, with an example in which the whole range of tones is distinguished in the syllable /si/. Note that some tones (the high rising tone, low falling tone and low rising tone) have alternative instantiations in different descriptions.

TABLE 1. Cantonese tone system

Tone	Description	Pitch Level	Example
1	High level	5-5	詩 si1 'poem'
2	High rising	3-5 or 2-5	史 si2 'history'
3	Mid level	3-3	試 si3 'to try'
4	Low falling	2-1 or 1-1	時 si4 'time'
5	Low rising	2-3 or 1-3	市 si5 'market; city'
6	Low level	2-2	事 si6 'matter; incident'

Traditional descriptions further distinguish the entering tones (high, mid, and low) on the checked syllables. In fact, they are instantiations of the high, mid and low level ones. Table 2 illustrates the 3 entering tones in Cantonese, with an example in which the range of tones is distinguished in the syllable /sik/. Note that the Linguistic Society of Hong Kong (LSHK) pinyin (romanization) system has already recognized that these entering tones are in fact shortened instantiations of the level tones; thus they are labeled according to their corresponding level tones in the system; i.e., Traditional tone 7 is labeled as Tone 1 in the LSHK system.

TABLE 2. Cantonese entering tone system

Tone	Description	Pitch Level	Example
7	High entering	5	色 sik7 ‘colour’
8	Mid entering	3	裼 sik8 ‘divest’
9	Low entering	2	食 sik9 ‘to eat’

This paper intends to provide a comprehensive analysis of the composition of lyrics in music of a tonal language. The relationship between lexical tones of the lyrics and the melody of the music is being addressed in particular. The focus of this study will be on Cantonese, because the tone system in Cantonese, including the sandhi rules, is clear and well documented in the literature. Besides, Cantonese is one of the languages in which lexical tones of the words must be taken into consideration during the composition of lyrics for a piece of music. Mandarin Chinese, for example, allows melodies to override the original tones; in the lyrics, tones seem to be ignored (Chan 1987). The main focus of this paper is to study whether Cantonese lyrics will adhere to the pitch contours and relative pitch heights of the tones in order to preserve in the lyrics the tonal details of the words.

1.1 LITERATURE REVIEW. Chao (1956) found that each lexical tone is sung with a consistent pitch pattern throughout the song in Chinese “Singsong” (a musical style that is intermediate between speaking and singing). A tone is always mapped with a particular musical note, e.g. high level tones are assigned to the musical note A4 (440 Hz). In such a case, listeners can reliably use the pitch pattern to identify tones and consequently words, thus preserving the intelligibility of lyrics.

Similarly, Yung (1983) found a melody-tone relationship in Cantonese Opera. Each lexical tone is sung on a small set of musical notes. For instance, high level tones are always sung on E5 (659.3 Hz), G5 (784 Hz), or D5 (587.3 Hz), while the mid level tone is consistently sung on C5 (523.3 Hz) and the low level tone is sung mostly on A4 (440 Hz) and occasionally on B4 (493.9 Hz). Yung also observed that there is never overlapping in the mapping between tones and musical notes.

There are a few preliminary studies in the literature investigating the tone-melody relationship in Cantopop. Chan (1987) found that lexical tones are maintained consistently among stanzas within a song. Tempo is the only key factor in affecting the tone-melody interface, which could lead to a loss, or partial loss, of pitch contours on rising tones in fast-tempo songs, but it never results in a tonal mismatch. Chan also suggested that the lyrics provided evidence of the underlying representation of the tones in the language, where the lexical tones are regarded as a sequence of level tones.

Wong and Diehl (2002) found that modern songwriters adopt an ordinal mapping rule for adjacent tones such that, for example, Tone 1 must only be higher in melodic pitch than Tone 3. This strategy allows greater melodic freedom while preserving adequate intelligibility of the lyrics. In their experiment, they also found listeners applied the same ordinal mapping rule in assigning tone categories when listening to songs.

It appears that Wong and Diehl (2002) found a less strict restriction on lyrics composition in Cantonese song than Chan (1987). From the classical Cantonese opera, to the modern songs in Wong and Diehl 2002, the restriction on preserving the pitch height and pitch contours of tones has loosened a great deal. Some insights for a possible explanation for the release of the tonal preservation restriction could be gained from the comments on modern Cantonese pop songs from a composer master in Cantopop, James Wong. In his dissertation presentation (2003), he mentioned that “lyrics nowadays are no longer making sense to [him]. People are focusing more on the melody, and just jumbled the words into the song.” This suggests why the pitch qualities of the tones are no longer strictly preserved; either the songwriters have put more emphasis on the melody, or they do not care about the tonal pattern of the lyrics anymore, just like the Mandarin songwriters.

This paper will look into some popular Cantonese children’s songs in Hong Kong to study the interactions between lexical tone and melody. Hong Kong is a city where Cantonese is spoken as the native language. Hong Kong music is chosen for two reasons. First, original music production in Hong Kong has

been established for a long time and is better developed than in other Cantonese-speaking regions, such as Southern China and South-East Asia. Furthermore, language and culture in Hong Kong have not been much influenced and contaminated by Mandarin, whereas many mainland China cities have already been "mandarinized". As noted above, Mandarin songwriters tend to ignore lexical tones in lyrics writing, and the degree of spread of this attitude in lyrics writing in the Cantonese-speaking region is unknown. It is very likely that sensitivity to the correlation between lexical tones and music in these "mandarinized" regions would have diminished to a certain degree. Therefore, to minimize the possible unknown linguistic effects from Mandarin and other lingua franca in the region, this study will focus on music that has originated from Hong Kong. It is worth noting that even though all these songs originated from Hong Kong, they are still widely known among the Cantonese-speaking population.

2. ANALYSES. A series of meta-analyses over a selection of Cantonese pop songs was carried out in this study. The first two analyses focused on the distribution of lexical tones in correlation with music and the relationship between tonal pitch and melody, respectively. The third analysis addressed how contour tones are dealt with in mapping lyrics with music.

2.1 MATERIALS. A total of six Cantonese children's songs were chosen for this analysis and the names of the songs are listed in the Appendix. The songs are all local Cantonese tunes.

All the melodies and lyrics were at least written between the 70s and 80s, whereas the origin and history of two songs, the "Let's guess which family the little chicks belong to?" and the "Number song", are untraceable. The reason that children's songs are chosen is that the tunes and lyrics of these songs are simple, so that the effect of tempo on lyrics and melody observed in Chan 1987 will not be a problem in this analysis. The content of the lyrics illustrates either various events in daily life, such as counting numbers and brushing teeth, or children's stories.

2.2 DISTRIBUTION OF TONES. This analysis investigates whether the distribution of lexical tones is conditioned by the height of the melodic tune. Put simply, it is looking for a correlation between the height of the musical note relative to the melodic tune of the song and the pitch height of the lexical tone relative to the tone scale.

2.2.1 METHOD. Tonal height is defined according to the common practice in the literature. The tones are divided into three levels of height: high, mid, and low. HIGH includes high level tone (Tone 1) and high rising tone (Tone 2), while LOW includes low falling tone (Tone 4), low rising tone (Tone 5) and low level tone (Tone 6) and MID only consists of mid level tone (Tone 3). A summary of the tonal height is presented in table 3.

TABLE 3. Tonal height

Height	Tone	Description	Pitch Level
High	1	High level	5-5
	2	High rising	3-5
Mid	3	Mid level	3-3
Low	4	Low falling	2-1
	5	Low rising	2-3
	6	Low level	2-2

Because the melodic range of each song differs, melodic height varies from song to song. The height is only a relative notion, as it is difficult to use an absolute scale to differentiate the height of different notes of a melodic pattern. Depending on the position of the note in the melodic range of the song, the melodic height is also divided into three levels: high, mid, and low. The method to draw the boundary of each level is by dividing the melodic range into three equal tiers (Melody I). If it is not divisible by three, adjustments will be made according to the frequency of occurrence of the notes on the periphery of the range. For example, if either the lowest or highest note only occurs once, then the corresponding tier will simply be expanded to include this note (Melody II). However, if it is a highly frequent note in the music,

then it will become a major member of the group, and all tier boundaries will be adjusted to maintain an equal number of members in the level (Melody III). An illustration of the height delineation is given in detail below in figure 1.

FIGURE 1. Illustration of melodic height delineation

Melody I: the height level of the melody boundary is evenly distributed, with two notes in each level, and the total frequency of each level is approximately the same. Melody II: Since Lower B ($B_|$) has only one occurrence in the music; it is included in the Low level without altering the settings of other levels. Melody III: The level boundary between the Low tier and the Mid tier is adjusted because of the high frequency of occurrence of the low G note.

Melody I: Teeth-brushing song

Height	Low		Mid		High	
Note	C	D	E	F	G	A
Frequency	5	4	6	3	8	1

Melody II: Number Song

Height	Low			Mid		High	
Note	$B_\|$	C	D	E	F	G	A
Frequency	1	1	6	4	4	9	1

Melody III: Little Universe

Height	Low		Mid			High		
Note	$G_\|$	C	D	E	F	G	A	C'
Frequency	16	5	17	28	3	7	5	2

The rationale of the adjustment is to reflect the probable perceptual judgment of the height differences in the melodic range. This also attempts to maintain a rough balance in the number of musical notes across each level to avoid a skewed distribution, in the hope of providing a better ground for testing the correlation between tonal height and melodic height.

The frequency of occurrence of lexical tones at each musical note is counted. For each song, the total frequency of each lexical tone at each melodic level (high, mid, or low) is calculated, and the percentage of occurrence is plotted against the total frequency of that particular tone in the entire song.

2.2.2 RESULTS. Tables 4–6 show the distribution of the lexical tones at the three melodic heights, respectively. The results are percentages reflecting the frequency of a particular tone found in each melodic level compared to its total occurrence in the entire song. For example, 50% of the words with a lexical tone 4 (low falling) in the lyrics were found to pair with a low note on the melodic level in the 'Little Sun' song.

TABLE 4. Distribution of lexical tone at LOW melodic level (in %)

Melodic Level	**High**		**Mid**	**Low**		
Tone	1	2	3	4	5	6
Pitch	5-5	3-5	3-3	2-1	2-3	2-2
Little Sun	6.9	0	7.7	50	16.7	3.7
Universe	21.2	0	37.5	100	53.8	40
Chicken	4.8	0	37.5	93.8	0	20
Hopscotch	25	28.6	44.4	100	100	55.6
Number	10	0	20	0	50	62.5
Teeth	25	0	11.1	100	0	0

TABLE 5. Distribution of lexical tone at MID melodic level (in %).

Melodic Level	High		Mid	Low		
Tone	1	2	3	4	5	6
Pitch	5-5	3-5	3-3	2-1	2-3	2-2
Little Sun	24.1	40	30.8	45.5	58.3	81.5
Universe	33.3	90	62.5	0	46.2	60
Chicken	81	85.7	50	6.3	20	40
Hopscotch	25	28.6	44.4	0	0	44.4
Number	0	100	60	0	50	37.5
Teeth	25	0	33.3	0	0	100

TABLE 6. Distribution of lexical tone at HIGH melodic level (in %).

Melodic Level	High		Mid	Low		
Tone	1	2	3	4	5	6
Pitch	5-5	3-5	3-3	2-1	2-3	2-2
Little Sun	65.5	60	23.1	4.5	25	7.4
Universe	45.5	10	0	0	0	0
Chicken	14.3	14.3	12.5	0	80	40
Hopscotch	50	42.9	11.1	0	0	0
Number	90	0	20	0	0	0
Teeth	50	100	55.6	0	0	0

Table 7 shows a summary of the lexical tones at all three levels. The numbers presented here are the median of all the percentages obtained from the six songs.

TABLE 7. Median of the percentages of distribution of lexical tone in melodic level across all six songs. Bold type indicates the highest percentage among the three melodic levels.

	Tonal Level	High		Mid	Low		
	Tone	1	2	3	4	5	6
	Pitch	5-5	3-5	3-3	2-1	2-3	2-2
Melodic Level	HIGH	50	28.6	16.25	0	0	0
	MID	25	62.85	47.2	0	33.1	52.2
	LOW	15.6	0	28.75	96.9	33.35	30

2.2.3 DISCUSSION. It is obvious that the distribution of the lexical tones corresponds with the melodic height by its pitch. A high level (5-5) tone will predominantly match with a high melodic note ($t(5)$= T score: 1.8949276, $p=0.05$), and a mid level (3-3) tone with a mid melodic note ($t(5)$= 2.5059247, $p=0.02$), whereas a low falling (2-1) tone is predominantly found with a low melodic note ($t(4)=5.6799927$, $p=0.002$), as predicted. In addition to a parallel matching of tone level with melodic level, lexical tones also display a tendency to avoid matching with a melodic level of a contrasting height. This is particularly apparent with the low and high tones. All the three low tones (2-1, 2-3, and 2-2) have never been matched with a high melodic note, while the high tones (5-5, 3-5) have a fairly low percentage of pairing with a low melodic note.

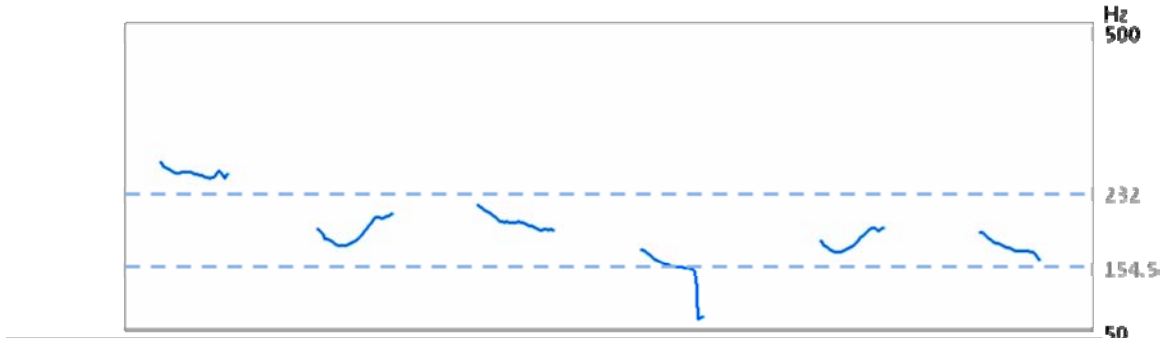
There are several interesting observations, however. The low level (2-2) tone has a high association with the mid melodic level instead of a low melodic level. The low rising (2-3) tone appears to have no preference in association with either the mid or the low melodic level. Similarly, the high rising (3-5) tone is predominantly found in a mid melodic level rather than corresponding to a high melodic level.

The non-conforming pattern of the three tones (low level, low rising, and high rising) can be explained by the actual acoustic qualities of the tones. Figure 2 shows pitch contours for the words listed in table 1, as read by the author. The high rising (3-5), the mid level (3-3), the low rising (2-3), and the low level (2-2) tones in fact lie in the same range in the middle (154.4 Hz – 232 Hz) and are far apart from the clearly high level (5-5) and clearly low falling (2-1) tones. This conforms to the pattern observed in the distribution of lexical tone on the melodic level, where the four tones mentioned above are predominantly associated with a mid melodic note. This suggests that the lyrics are sensitive to the actual pitch qualities of the tones as well as the relative frequencies of notes within the melody.

Even though the low rising (2-3) and low level (2-2) tones are predominantly found in the mid melodic range, their correspondence with the low melodic level is not low either. The boundary between tonal levels may not be as rigid as categorized, and the tones that are near the low range might be perceived as a low tone in some situations. Whether these situations are determined by the surrounding environment of the tone leads us to the next analysis, which looks at the relationship of tonal pattern of neighboring pairs of tones.

FIGURE 2. Pitch contour of the Cantonese tone system

Each word is pronounced with the syllable /si/ and is minimally differentiated by tone. The mid range of tone level is delineated by the dashed line.



Tone	1	2	3	4	5	6
Pitch	5-5	3-5	3-3	2-1	2-3	2-2

2.3 TONAL PITCH-MELODY RELATIONSHIP BETWEEN NEIGHBORING TONES. If lexical tone poses restrictions on lyrics writing, which property of the tones will be the essence of such criteria? The next part of the analysis will look into the relationship between the trends of the tonal contour and the melodic contour and will ask if there exists any underlying determining factor.

When tones carry very important information for processing that must not be missed, preserving the tonal contour pattern becomes a fairly important task for the lyricist if the lyrics are to be comprehensible. Following this line of reasoning, the melodic tune and the tonal contour should show a parallel pattern in order to preserve the tonal pitch sequence. For example, a rising melodic line should correspond to a rising tonal sequence, and a falling melodic line to a falling tonal sequence.

2.3.1 METHOD. The trend relationship refers to the difference in pitch between two adjacent melodic notes and two adjacent lexical tones. The relationships are categorized into three types: rise (from a lower note/tone to a higher note/tone), fall (from a higher note/tone to a lower note/tone), and level (no change between the two notes/tones). After the relationship is labelled, the trends of the melody are compared to the trends of tonal pitch. The proportion of matching and mismatching trends is calculated. Figure 3 gives an example of the relationship assignment.

FIGURE 3. Relationship assignment between melody and tone

Step 1: Treatment of pitch assignment is the same across melody and lexical tone. If the previous note/tone is higher/lower/at the same level as the following note, a fall/rise/level trend will be assigned respectively.

Step 2: The melody and tone trends are compared. If the two trends are the same, for example if both have a falling trend, the pair of notes/tones will be marked as having a matching relationship between its melody and its tonal trends.

Step 1: Assignment of pitch trend

Note Pair (m, n)		(1, 2)	(2, 3)	(3, 4)	(4, 5)	(5, 6)	
Melody							
Note m	--	5	3	5	5	3	5
Note n	5	3	5	5	3	5	…
Trend	--	fall	rise	level	fall	rise	…
Lexical Tone							
Note m	--	3 (3-3)	6 (2-2)	3 (3-3)	3 (3-3)	6 (2-2)	3 (3-3)
Note n	3	6 (2-2)	3 (3-3)	3 (3-3)	6 (2-2)	3 (3-3)	…
Trend	--	fall	rise	level	fall	rise	…

Step 2: Match/Mismatch comparison

Note Pair	(1, 2)	(2, 3)	(3, 4)	(4, 5)	(5, 6)
Melody Trend	fall	rise	level	Fall	rise
Tone Trend	fall	rise	level	Fall	rise
Mis/Match	MATCH	MATCH	MATCH	MATCH	MATCH

The melodic trend is based on the comparison of the actual music notes, while the tonal difference is calculated upon the tonal pitch scale illustrated in table 1. Tone 4 (low falling, 2-1) should be the lowest point in the tonal contour, and ascending to Tone 6 (low level, 2-2), then Tone 5 (low rising, 2-3), followed by the mid and high tones. The highest point of the tonal pitch contour should be Tone 1 (high level, 5-5). This assumes that each tone is an indivisible unit, and disregards the difference between level tone and contour tone. Therefore, a tone with two different components is primarily categorized according to the pitch of its first component, and the second component will determine the final ranking of the tone within the tonal level. For example, the tones that begin with the pitch level 2 are all regarded as LOW tone. Within the LOW tonal level, level tone (2-2) is higher than the falling tone (2-1) because the second component of level tone is higher than that of falling tone. Rising tone (2-3) is higher than level tone (2-2) for the same reason. Further analysis is needed to determine whether such an assumption is correct. It is possible that both components have a significant effect on the perception as well as other issues concerning the lexical tone.

2.3.2 RESULTS AND DISCUSSION. Table 8 shows the percentage of matches and mismatches between the tonal sequence of the lyrics and the melodic pattern of the music. The relationship is counted as a match if the tonal sequence falls/rises/levels while the melodic line falls/rises/levels as well.

TABLE 8. Relationship between tonal contour and melodic pattern

(%)	Sun	Uni-verse	Chick-en	Hop-scotch	Num-ber	Teeth
match	75.7	74.2	80.5	64.2	92	88.5
mismatch	24.3	25.8	19.5	35.8	8	11.5

A one-tailed t-test demonstrated that an effort is indeed put into the choice of words to maintain a close correspondence between the tonal contour and the melodic contour (Mean: 79.2%; $t(5)= 7.048564$; $p<0.001$). In every song, the matching relationships are significantly higher than mismatching relationships. The parallelism of the rise and fall between the melody of the music and the tonal contour of the lyrics could reinforce the comprehensibility of the lyrics in the song. A close correspondence between melody and tones helps to preserve the original tonal quality and the tonal distinction of the words, and thus the message in the lyrics can be conveyed unambiguously.

2.4 CONTOUR TONES. In Cantonese, there are three contour tones: low falling (2-1), low rising (2-3), and high rising (3-5). All these tones are composed of two tone components, an onset (left) and a offset (right) component. Except the low falling tone (2-1), the components of the other two contour tones are located at different height levels, and the pitch contour crosses the pitch tier boundary. The low rising tone (2-3) begins from a low pitch level (2) and rises to a mid pitch level (3), while the high rising tone (3-5) begins from a mid tone level (3) and rises to a high tone level (5). If lexical tones are distributed based on the match of their pitch height to the melodic height of the music, in which high tones are found with high notes and so on, the distribution of the rising tones would shed some light on how compound tones are being treated. This analysis will investigate which property of the contour tone determines its relationship with the neighboring tones and the overall pitch-melody relationship.

There are four different hypotheses of how contour tones can be treated in music, stated as follows:

H1: The contour tone is treated as one single tone and is regarded as a special category of tones. The contour tone category will be treated differently from the level tone category.

H2: The two components of a contour tone are treated separately as individual tones. The two components will individually be given the same treatment as other tones of the same level.

H3: One of the two components in the contour tone becomes the dominant pitch of the entire tone and the pitch-melody mapping will only take the qualities of the dominant component into account.

H4: The categorization of the contour tone depends on its neighboring environment. The tonal qualities of the neighbor tone will interact with certain qualities of the contour tone. Treatment of contour tones will be conditioned by its neighbor tone and will vary according to the environment. Under this hypothesis, there are two possible outcomes: the contour tone will either (a) assimilate to or (b) distinguish itself from its neighbor tone. In either case, the tone will shift between the dominance of its components regarding to the tonal qualities of the neighbor tone.

If H1 is true, a homogeneous treatment, distinctly different from other types of tones, will be found for all three contour tones in Cantonese. On the contrary, if H2 is true, contour tones will be predominantly found paired with two musical notes, and each note corresponds to each component of the contour tone. Neither H1 nor H2 seems to be plausible, since the observations from the analyses mentioned above do not support the predictions from these two hypotheses. This leaves us with the question of whether a contour tone is dominated by one of its two components (H3), or whether its interaction with the environment and the dominance of the components are conditioned by neighboring tones (H4).

If a rising tone is predominantly given the same treatment as other tones that are at the same level as one of its components—for example if the high rising tone (3-5) always demonstrates the same behavior as a mid level tone (3-3)—H3 will be supported. Alternatively, if a rising tone is treated differently in different tonal environments, this will support H4. If a contour tone assimilates to its neighbor, a high rising

tone (3-5) will demonstrate behavior as a high tone when its neighbor is a high tone, but will show mid tone behavior when a mid tone is next to it. In contrast, if the tones prefer to distinguish themselves from one another, a high rising tone should behave as a mid tone when a high level tone is adjacent to the rising tone, or vice versa.

2.4.1 METHOD. The analysis focused on the two contour tones: high rising (3-5) and low rising (2-3) tone. The behavior and interaction with the environment of the rising tones are observed in two environments: (i) the preceding tone; and (ii) the following tone. In the example shown in figure 4, separate analyses are performed on (i) the preceding note/word (region 4 and 5), and (ii) the following note/word (region 5 and 6). The same analysis technique as in section 2.2 was applied.

FIGURE 4. Lyrics and melody of the third stanza of the Number Song

Region	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Lyrics	jat1 'one'	ji6 'two'	saam1 'three'	sei3 'four'	m5 'five'	luk6 'six'	cat1 'seven'
Melody	5	3	6	5	2	L7	2
Pitch	5-5	2-2	5-5	3-3	2-3	2-2	5-5

2.4.2 RESULTS AND DISCUSSION. Some instances were omitted from the analysis: to avoid biasing effects, only one of three repeating cases of the high rising tone preceded by high rising tone was counted. There is also one case that the high rising tone preceded by low rising tone was deleted because the song was repeated from the beginning and the deleted pair was made up of the last word and the first word of the song, which did not necessarily have any causal relation.

Tables 9 and 10 show the frequency of tone-melody relationship (percentage in brackets) of the rising tone with its neighboring tone in (i) a preceding context; and (ii) a following context, for all songs combined.

TABLE 9. Melodic relationship of low rising tone (2-3) with preceding tone (left) and following tone (right).

		preceding (-- 23)			following (23 --)		
Melodic trend		rise	fall	level	rise	fall	level
Lexical tone							
level	2-2	14 (100%)	0	0	0	13 (100%)	0
	3-3	0	5 (100%)	0	0	1 (25%)	3 (75%)
	5-5	0	11 (100%)	0	8 (100%)	0	0
rising	2-3	2 (66.7%)	0	1 (33.3%)	2 (66.6%)	0	1 (33.3%)
	3-5	0	1 (100%)	0	2 (100%)	0	0
falling	2-1	--	--	--	0	1 (100%)	0

TABLE 10. Melodic relationship of high rising tone (3-5) with preceding tone (left) and following tone (right)

		preceding (-- 35)			following (35 --)		
Melodic trend		rise	fall	level	rise	fall	level
Lexical tone							
level	2-2	5 (100%)	0	0	0	4 (100%)	0
	3-3	1 (50%)	0	1 (50%)	0	2 (66.7%)	1 (33.3%)
	5-5	4 (44.4%)	3 (33.3%)	2 (22.2%)	6 (50%)	4 (33.3%)	2 (16.7%)
rising	2-3	2 (100%)	0	0	0	1 (100%)	0
	3-5	1 (25%)	0	3 (75%)	1 (25%)	0	3 (75%)
falling	2-1	5 (100%)	0	0	0	3 (100%)	0

When the neighbor, either to the left (preceding) or to the right (following), is a level tone (2-2, 3-3 or 5-5) or a falling tone (2-1), the melodic trend faithfully reflects the pitch trend of the low rising tone (2-3) with its neighbor. It is evident from the observations of low rising tone that the difference in pitch height even with one of the components is sufficient to determine the melody trend matching. It appears that the position of the components does not influence the interaction with the neighboring environment. When a low rising tone (2-3) is preceded by a low level tone (2-2), the melodic trend shows the rising trend, and when a low rising tone (2-3) is followed by a low level tone (2-2), the melodic trend shows the falling trend. When the neighboring tone is a high level tone (5-5), the melodic trend rises when it follows a low rising tone (2-3), whereas the melodic trend falls when it precedes a low rising tone. The melodic trend also rises when a mid level tone (3-3) precedes a low rising tone (2-3). However, the melodic trend could either be a falling trend or a level trend when a mid level tone (3-3) follows a low rising tone (2-3).

The observations here suggest that the position of a component does not make it become a dominant component of the tone. There seems to be no requirement to refer to a particular component when the tone-melody matching is performed. The existence of a difference in tone quality within a contour tone directs the correspondence between tone and melody, and no dominance can be attributed to either component in the contour tone.

Results are not as clear for the high rising tone (3-5). Similar to the low rising tone, the melodic trend reflects the change in pitch height when a high rising tone (3-5) is preceded/followed by a low level tone (2-2)—i.e., the melodic trend is a rising trend when the low level tone precedes the high rising tone and is a falling trend when the low level tone follows the high rising tone. However, the situation becomes less clear in cases of mid level tone (3-3) and high level tone (5-5). The melodic trend between a high rising tone (3-5) and a mid level tone (3-3) only shows a tendency instead of a faithful melodic trend reflection of the change in pitch height between the components of the two tones. The tendency is not as strong however. The relationship with high level tone (5-5) is even more random. The melodic trends between high rising tone (3-5) and high level tone (5-5) are found quite evenly distributed among rising, falling, and level transition in either direction.

When the neighboring tone is a rising tone, the contrast between high rising tone (3-5) and low rising tone (2-3) is clear. Because the two components of the two rising tones are of completely different pitch levels, they show a clear tendency of melody trend matching with the change in pitch levels of the two tones. However, when two rising tones of the same level are placed next to each other, there is a difference in behavior between the low and the high rising tones. Low rising tone (2-3) tends to maintain the rising quality of the tone in the music, and therefore the melody trend is always rising in either direction. On the other hand, there is a tendency to maintain a level melodic trend when two high rising tones (3-5) are situated next to each other.

A possible explanation for the observed differences between high rising and low rising tone across the level tones might be that pitch level 3 and 5 are in fact perceived closer than 2 and 3. Chan (1987) demonstrated that high rising tone and high level tone were often minimally paired in lyrics with the same line of music, which leads her to argue that tonal compositions have treated contour tones as level tones by reducing the onset component and only the offset component remains, for example a high rising tone (3-5) will become a high level tone (5-5). Although Chan's argument is not completely true, since the onset

component of contour tones has been demonstrated above to be equally important in determining tone-melody relationship as the offset component, her observation suggested that pitch level 3 and 5 might be of a closer perceptual distance, so that the boundary between these two levels is not as strict as that between 2 and 3. In other words, HIGH and MID are perceptually closer than LOW and MID. As a result, the melody trend matching that involves tones with pitch level 3 and 5 is more flexible than the matching that involves tones with pitch level 2.

Contour tones are neither found to be treated as a special category nor to have the components regarded as individual tones. The observations here suggest that a contour tone interacts with its neighbors, and the pitch difference between either components of the contour tone with the neighbor tones determines the tone-melody correspondence. This provides evidence in support of the hypothesis that tone-melody correspondence is conditioned by the environment. Furthermore, pitch values appear to influence whether the contour tone will assimilate or dissimilate from its neighbor tones. If the pitches of the two tones are (perceptually) close, it is very likely for the two to assimilate to each other, as suggested by the level melodic trend found only in pairs of tones that involved pitch level 3 and 5. Otherwise, tone-melody correspondence tends to preserve the tonal distinctions as much as possible by conserving the tonal pitch contour. By doing so, it helps to preserve the tonal information, which is important for maintaining the comprehensibility of the lyrics and guaranteeing that the intended message is preserved in the music. One down side of this study is that the number of occurrences of rising tones is rather low in these six songs and it would be better if a larger number of instances could be included and considered in the analysis. This would undoubtedly increase the significance of the current observations.

3. CONCLUSION. Restrictions regarding tones apply when mapping lyrics with music in Cantonese. Three such restrictions are revealed in this study:

1. The melodic tier of music and the pitch tier of tones should match.
2. The trends of the melodic contour of music and the pitch contour of tones should match.
3. Contour tones are found not to be treated differently as a special category, nor as a sequence of tones. In fact, a contour tone interacts with its environment, and the difference in the pitches of the components determines the relationship between tone and melody.

This study provides only a phonological analysis of how lyrics are correlated with music, in which contributions and variations induced from actual production and perception have not yet been considered. The actual production and perception of tones might be able to provide some insights or explanations about the observed variations, such as the seemingly random pattern observed in the high pitch tones. If there are differences between the phonemic representation and the actual phonetic level, the details of the latter might help to account for why tones are mapped to the melody in a particular fashion. It is logical to believe that the composers have created the song with considerations of how it is going to be sung or perceived in the mind. To understand whether and how actual phonetic articulation is considered during lyrics and music composition, further research will be needed to investigate the actual articulation of tones in the lyrics and compare it with current investigations of the phonemic tonal representation and to what degree it maps better to music than the phonemic representation.

APPENDIX: SONG INFORMATION

小太陽 **‘Little Sun’**
siu5 taai3joeng4
small sun

小小的宇宙 **‘Little Universe’**
siu5 siu5 dik1 jyu5zau6
small small POSS universe

跳飛機 **‘Hopscotch’**
tiu3 fei1gei1
jump aeroplane

數字歌 **‘Number song’**
sou3zi6 go1
number song

刷牙歌 **‘Teeth-brushing song’**
caat3 ngaa4 go1
brush teeth song

何家小雞何家猜 **‘Let’s guess which family do the little chicks belong?’**
ho4 gaa1 siu5 gai1 ho4 gaa1 caai1
which family little chicken which family guess

REFERENCES

Chan, Majorie K. M. 1987. Tone and melody in Cantonese. In *Proceedings of the Thirteenth Annual Meeting of the Berkeley Linguistics Society*, Berkeley, California, 26–37.

Chao, Yuen Ren. 1956. *Cantonese primer*. Cambridge, MA: Harvard University Press.

Wong, Patrick C. M., and Randy L. Diehl. 2002. How can the lyrics of a song in a tone language be understood? *Psychology of Music* 30:202–9.

Wong, Jum-sum James. 2003. The rise and decline of Cantopop: A study of Hong Kong popular music (1949–1997) = 粵語流行曲的發展與興衰: 香港流行音樂研究 (1949–1997). University of Hong Kong PhD thesis.

Yung, Bell. 1983. Creative process in Cantonese opera I: The role of linguistic tones. *Ethnomusicology* 27:29–47.

elau@hawaii.edu