Tonal Aspects of Languages 2016
24-27 May 2016, Buffalo, New York

Tone-melody correspondence in Vietnamese popular song

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Abstract

We examine the degree of correspondence between musical and linguistic tone sequences in a corpus of 20 Vietnamese popular songs. Our data suggest that text-setting constraints in Vietnamese, as in some other Asian tone languages, are based primarily on the direction of the pitch transition from one syllable/note to the next. Borrowing some musical terminology, we may say that 'similar motion' is favoured, 'oblique motion' is allowed in certain cases, and 'contrary motion' is disfavoured. As with other Asian tone languages, the definition of these three types of motion depends on the categorisation of the linguistic tones; our current best model achieves a rate of 77% similar motion. We hypothesize that avoidance of contrary motion may be as or more important than achieving correspondence between tonal and melodic transitions in Vietnamese popular song.

Index Terms: Tone, text-setting, music, Vietnamese

1. Introduction

A long-standing question about singing in tone languages is as follows: if pitch is being used to distinguish meaning, how can speakers of tone languages understand lyrics when they are set to music? In other words, how is (linguistic) tone reconciled with (musical) melody?

A small but growing body of research is beginning to make clear that this question is an instance of a more general problem of satisfying potentially conflicting linguistic and musical constraints. Native speakers of non-tonal languages familiar with a particular tradition of sung or chanted verse can readily set novel lines to existing rhythms, with a significant degree of agreement. This ability was studied in detail by Halle and Lerdahl [1], who dubbed it the 'text-setting problem'. They demonstrated how the relationship between metrical and musical structure can be formalised by comparing metrical and musical grids and assessing the degree to which they are aligned. The question then arises of whether comparable constraints exist in tone languages that govern the ways in which tonal sequences can be set to musical melodies.

In this paper, we consider the correspondence between tone and melody in Vietnamese, an Austroasiatic language with a rich musical tradition and a complex tone system. Using a corpus of *tân nhạc* or 'new music', we explore the extent to which tone-tune alignment obtains, discuss possible explanations for divergence from correspondence, and compare the findings to previous studies of tone-tune alignment.

2. Background

2.1. Previous studies of tone-tune alignment

A number of studies of tone-melody correspondence have been conducted, the majority on Thai or Chinese languages. The central finding that emerges from this work is that, by and large, tonal text-setting constraints involve constraints on *sequences* of notes and syllables. That is, the linguistically specified tonal contours on individual syllables tend not to be manifested in the musical melody. Rather, for any given pair of syllables in a sequence, the direction of linguistic pitch change from the first syllable to the second tends to be reproduced in the sequence of musical notes: if the linguistic pitch goes up from one syllable to the next, there is a preference for the musical melody to go up on the corresponding notes, and so on. Slightly adapting standard terminology from music theory, we can refer to this constraint as a preference for *similar motion*. We also note the existence of *oblique motion* (where two syllables in a bigram have the same linguistic tone but the musical notes differ, or where the two syllables have different linguistic tones but are rendered musically on the same note), and *contrary motion*, with opposite pitch direction across the linguistic and musical bigrams.

A strong preference for similar motion has been demonstrated for classical operatic forms in Cantonese [2], Mandarin [3] and Thai [4]. In these genres, tone and melody almost always move in the same direction; Yung [2] goes so far as to state that 'the most important factor in the formation of melodies is probably the linguistic tones of the text' (p39). List [5] and Saurman [6] also document a high degree of tone-tune alignment in various types of Thai vocal music, but both authors note that the degree of alignment depends to some extent on genre: a higher degree of tone-melody correspondence is found in classical and traditional songs, with significantly less similar motion in contemporary, Western-influenced pop.

However, even in popular music, tone-melody alignment may obtain to varying degrees. The popular music produced in Hong Kong ('Cantopop') has been examined by a number of authors [7, 8, 9, 10, 11], all of whom have found that alignment of tonal and melodic transitions is both empirically robust and salient to listeners [9]. This contrasts with studies of Mandarin popular music [9, 12] where little or no tone-melody correspondence is reported (but cf. [13]). More recently, [14, 15] have investigated tone-melody mappings in Thai pop music, where they also find a significant degree of similar motion.[1]

Despite a larger number of speakers and a rich musical tradition (both traditional and contemporary), tone-melody alignment in Vietnamese remains virtually unexplored (but see [17], Chapter 5 for a preliminary analysis of tone-melody correspondence in *chầu văn* ritual music and [18] for some historical perspective and comments on the issues involved).

[1]Studies of tone-tune correspondence have also been conducted for some African tone languages (see [16] for a review). While similar motion is also observed in these languages, it tends to be significantly less constrained than in Asian languages. For reasons of space, we focus here on the literature pertaining to Asian languages.

http://dx.doi.org/10.21437/TAL.2016-10

2.2. Vietnamese

Vietnamese denotes a group of more or less mutually intelligible dialects spoken in Vietnam [19]. Northern Vietnamese, the dialect in which many composers of a certain era tacitly or explicitly composed and in which singers (until quite recently) tended to perform regardless of their dialect background, has 8 phonetically distinct tones: 6 in open syllables and 2 in obstruent-final syllables [20, 21]. The two obstruent-final tones are often taken to be allophonic variants of the rising and checked tones, despite significant phonetic differences in their realization [20].

There does not exist a universally accepted technical notation for Vietnamese tones. Here, we use the numerical notation indicating relative pitch height proposed by [22] (1=low, 5=high) with the additional use of 'g' to represent glottalization, an important feature of Northern Vietnamese tone production and perception [20, 23]. Note that while the low falling tone is canonically realized as falling-rising in formal speech, colloquially it is realized as a low fall [21, 23].

Table 1: *Tones in Northern (Hanoi) Vietnamese.*

Tone	Description	Example
33	Level	*ba* 'three'
32	Mid falling	*bà* 'grandmother'
24	Rising	*bá* (title of nobility)
2g	Checked	*bạ* 'register'
21	Low falling	*bả* 'poison'
3g5	Broken	*bã* 'waste'

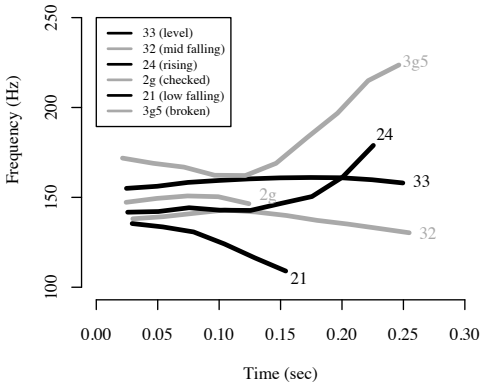

Figure 1: *Northern (Hanoi) Vietnamese tones (after [21]).*

3. Method

Here, we focus on tone-tune correspondence in Vietnamese *tân nhạc* or 'new music', a term for a group of Western-influenced genres such as *nhạc vàng, nhạc trữ tình, nhạc đỏ*, etc. [24, 25]. Our analysis is based on a convenience sample of 20 songs composed between 1946 and 1957 for which printed scores could be obtained. The scores were converted to MusicXML and processed to extract data on note and tone sequences.

A typical example is given in Figure 2, which shows the first phrase of the song *Bà mẹ quê* by the famous songwriter and folk singer Phạm Duy. When syllables are indicated as being realized over more than one note, as in the two syllables *ngát một* of the 3rd measure, the first note was used when determining the melody contour with respect to the preceding syllable, and

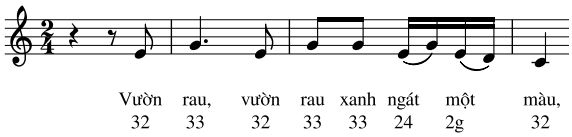

Figure 2: *The first phrase of* Bà mẹ quê *by Phạm Duy, with numerical tone values given below the lyrics.*

the final note when determining the contour with respect to the following syllable. In this example, both the melodic transitions from *xanh* to *ngát* and from *ngát* to *một* would be classified as falling, as they would be computed based on an onset of G and an offset of E in both instances.

Although it is straightforward in theory to apply the idea of similar, oblique and contrary motion to tone-melody correspondences, in practice it can be difficult to decide whether to treat a given tonal bigram as rising, level, or falling. For example, a tonal sequence 32-24 might be classified as level (the transition from offset 2 to onset 2), falling (the transition from onset 3 to onset 2) or rising (the transition from either onset 3 to offset 4, or offset 2 to offset 4). The approach taken here was to enumerate all of the 4,683 possible ordered partitions[2] of the set of 6 tones, and then to rank them based on the rates of similar and contrary motion which obtain under that ordering. For example, in the partial ordering $\{24\} > \{33,32\}$, tone 24 would be treated as higher in pitch than tones 33 and 32, but these two tones would be treated as equal in pitch for the purposes of determining the direction of a tonal bigram.

The ordering which maximized similar motion (77%) while minimizing contrary motion (4%) was $\{3g5,24\} > \{33\} > \{32\} > \{21,2g\}$. We also found several other orderings having the same rate of similar motion with slightly higher rates of contrary motion (5-6%). Despite some differences in detail, what is common to all of these rankings is that the rising (24, 3g5) and level (33) tones are treated as higher than the falling (32, 21) and checked (2g) tones for the purposes of tone-tune alignment. This is consistent with previous work on Cantopop, where it has been clearly shown that ordering of tones based on pitch offset yielding the highest rates of similar motion [7, 8, 9, 11]. The full corpus and code to replicate our analysis can be found in [27].

In their studies of Cantopop, [9, 11] note that many cases of contrary motion occur at melodic phrase boundaries. [9] speculates that tone-melody mapping constraints may not be active in such environments. Thus, in our analysis we excluded transitions that spanned a musical phrase boundary (7%, or 262 of 3807 total transitions). Phrase boundaries were determined by hand (see Figure 4 for an example), and usually coincided with a syntactic clause boundary and/or a musical cadence.

4. Characteristics of Vietnamese tone-melody correspondence

4.1. Similar motion

Table 2 shows the rates of tone-melody correspondence for the ordering $\{3g5,24\}>\{33\}>\{32\}>\{21,2g\}$. Similar motion is seen across the main diagonal (bold-faced cells); the overall degree of similar motion was 77%. If transitions across musical phrase boundaries are included, this is reduced to 75%.

[2]The number of ordered partitions of a set of n items is given by its Fubini number $a_n = \sum_{k=0}^{n} S(n,k)k!$ [26].

Table 2: *Correspondence between melodic and tonal transitions. Percentages are per column. Bold-faced cells (main diagonal) are similar motion; shaded cells are contrary motion; remaining unshaded cells are oblique motion. Overall degree of similar motion: 77% (2720 of 3545 transitions).*

		melodic sequence		
		up	*down*	*same*
tone sequence	*up*	**1136 (78%)**	81 (6%)	84 (14%)
	down	72 (5%)	**1111 (76%)**	59 (10%)
	same	256 (17%)	273 (19%)	**473 (77%)**

4.2. Contrary motion

Contrary motion describes the situation where the tonal transition and the melodic transition move in opposite directions. Figure 3 plots the small number of instances of contrary motion observed in our corpus (153, just 4% of total). Many instances involved the sequence 32-2g, some examples of which are given in Figure 4. These are interesting in that, unlike the examples discussed by [9], the mismatches are not always occurring across musical or syntactic phrase boundaries. In Figure 4, for instance, *ngần ngại* is an unanalyzable disyllabic compound with the meaning 'to hesitate'. Assigning 32 and 2g the same rank resolves these sequences, leading to a reduction in cases of contrary motion, but doing so also increases the number of cases of oblique motion, as in both directions these are now treated as a level sequence and therefore mismatched with both falling and rising note sequences.

4.3. Oblique motion

Oblique motion refers to the cases where either the tonal or melodic transition stays level but the other line is ascending or descending (unshaded, non-bold cells in Table 2). Examples of both types can be seen in Figure 5. For the ordering discussed here, 19% (672 transitions) were classified as oblique motion.

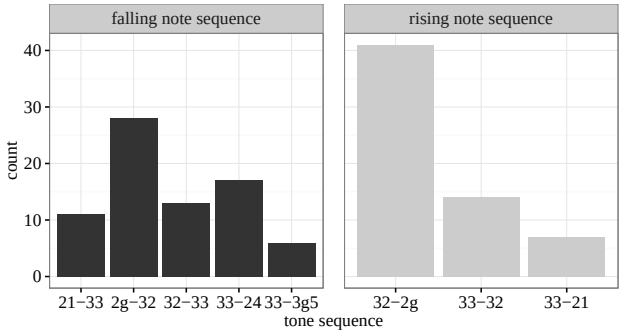

Figure 3: *Occurrences of contrary motion, where tonal and melodic transitions move in opposite directions. For clarity, only pairs that occurred 5 or more times are plotted.*

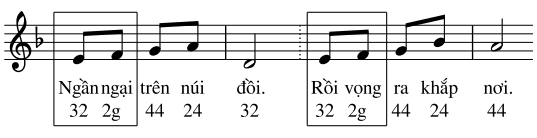

Figure 4: *Two phrases from* Hòn Vọng Phu 1 *by Lê Thương, showing examples of contrary motion involving tones 32 and 2g (boxed transitions). The dashed line indicates the musical phrase boundary, over which transitions were not calculated.*

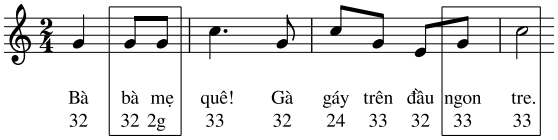

Figure 5: *A line of the chorus from* Bà mẹ quê *showing both types of oblique motion (boxed transitions).*

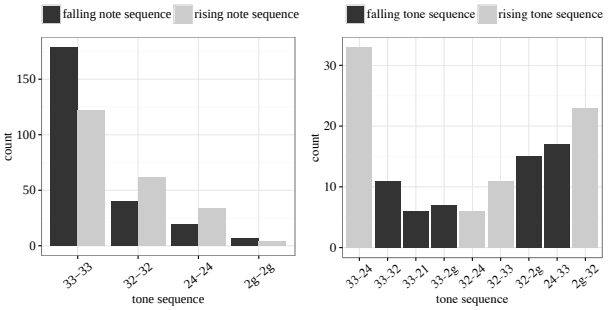

Figure 6: *Oblique motion. Left: tonal transition level, melody transition rising or falling. Right: uneven tonal transitions occurring with level melodic transitions. For clarity, only pairs that occurred 5 or more times are plotted.*

The most common type of oblique motion observed (529 of 672 instances) is when the tonal transition stays level but the melodic transition rises or falls (the second boxed transition in Figure 5). As seen in the left panel of Figure 6, this tends to occur most often with sequences of level tones, suggesting they are perhaps somehow 'neutral' with respect to constraints on tone-melody alignment. The finding that the main tolerated case of oblique motion involves sequences of high-level tones and falling melodies has also been observed in Cantopop [9, 11].

The right panel of Figure 6 plots uneven tonal transitions occurring with even melodic transitions (the first boxed transition in Figure 5). Both rising and falling tonal transitions occur with roughly equal frequency, with many involving the level tone 33 (92 of 143 transitions). The involvement of the level tone here seems intuitively reasonable, and may be related to phenomena such as declination and downstep (whereby same-tone sequences are accompanied by a global fall in pitch). The frequent appearance of rising 24 tone (58 transitions) suggests that this tone may be treated as a level tone for purposes of tonal alignment in some circumstances (cf. [14]).

4.4. Realization of contour tones

While contour tones are sometimes realized melismatically (i.e. over multiple notes), they are also frequently realized over single notes, while level tones are also realized over multiple notes. In our current corpus of 3827 syllables, just 9% (335) were realized melismatically (see Figure 2 for examples). Of these, 110 (33%) were level tones (33), 98 (29%) were rising tones (24) and 43 (13%) were falling tones (32). Note that this does not take into account performance-based phonetic modifications, i.e. cases where a performer introduces a melisma that is not indicated in the score; however, it does suggest that composers are not systematically indicating that syllables with contours tones

must obligatorily be sung as melismata. The apparent lack of attention paid to tonal contour by composers in Vietnamese is in line with results from other Asian tone languages [8, 9, 11, 14].

5. Discussion

While the degree of similar motion found for our sample of Vietnamese *tân nhạc* is less than the 91.8% reported by [8] for Cantonese, it is comparable the rates reported in subsequent studies of Cantopop [9, 11]. More striking is the fact that oblique motion seems to be tolerated in *tân nhạc*, compared to Cantopop, where it may be avoided to a greater extent [11]. As seen in Section 4.3, oblique motion primarily involves sequences of identical (usually level) tones set to rising or falling melodies. In contrast, contrary motion is extremely rare in our corpus, suggesting it is actively avoided by composers.

Like Cantonese, Vietnamese tonal text-setting constraints appear to primarily target the tonal offset. However, contour appears to be relevant as well: ordering the rising (3g5/24) tones relative to one another fails to significantly improve correspondence between tone and tune. Similarly, there does not appear to be a preferred ordering of the low laryngealized tones 21 and 2g. Nevertheless, the variable status of the checked tone 2g may involve voice quality: here, we have coded both sonorant-final and obstruent-final syllables bearing this tone as 2g, as they are identically indicated in the orthography, but obstruent-final syllables, e.g. *mạt* [mat̚]'louse', are realized with modal voicing, while sonorant-final syllables, e.g. *mạ* [maʔ] 'rice seedling', are heavily glottalized [20]. Given the central role of voice quality in the perception and production of Northern Vietnamese tone, this issue deserves further investigation.

6. Conclusions

Our study of Vietnamese *tân nhạc* suggests that tone-melody correspondence is fairly high in this language and genre. As in Cantopop, the relevant constraints generally appear to reference tonal offset. The majority of the observed correspondences between tonal and melodic bigrams are similar. Oblique motion is tolerated to a certain degree, particularly when level tone are involved, while contrary motion is comparatively rare. These results suggest that avoidance of contrary motion may be as or more important than achieving 'parallelism' between tonal and melodic transitions in Vietnamese popular song.

7. Acknowledgements

This work was supported by the Arts and Humanities Research Council grant AH/M005240/1 'Singing in tone: text-setting constraints in Southeast Asia' to J. Kirby.

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