THE REGISTER TONAL FEATURE AND THE NEUTRAL TONE IN MANDARIN

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In this paper I will discuss Yip's (1980) system of tonal features as it applies to the neutral tone of Mandarin. In particular I will demonstrate a number of problems posed for Yip's tonal features when it applies to the Mandarin neutral tone.

Yip's system of tonal feature has exerted a major influence on subsequent studies of Chinese tones. Being virtually the only non-linear analysis of Chinese tones for more than a decade, Yip's system has been adopted in a number of studies of Chinese tones (e.g. Bao 1990, Shih 1986, Packard 1989, Pulleyblank 1986, Yip 1989a,b, among others). However, in recent years, Yip's system has been challenged in a number of studies (Packard 1989, Zee 1991). Zee (1991), for instance, produced evidence from Shanghai to show that Shanghai is fundamentally a three, rather than four level tonal system, and therefore, Yip's tonal feature system which defines four levels does not work for the analysis of Shanghai tones. A similar finding is made in Lin (1992) with regards to Madarin tones. In this paper, however, I will only focus on Yip's analysis of the Mandarin neutral tone and discuss a number of problems with it. I will begin the discussion of these problems with a brief introduction to Yip's tonal feature system.

1. YIP'S REGISTER FEATURE SYSTEM

The most unusual aspect of Yip's tonal feature system is probably its use of an unconventional Register Feature *[upper]*. This feature and the feature *[high]* are the two component features in Yip's featural analysis of Chinese tones. Called Register Feature and Tonal Feature respectively, these two features interact to define four tonal levels:

(1)

Register Feature	Tonal Feature	Chao's Scale	Four Tonal Level Defined
[+upper]	[+high] (H)	5	[+upper, H]
	[-high] (L)	4	[+upper, L]
		3	
[-upper]	[+high] (H)	2	[-upper, H]
	[-high] (L)	1	[-upper, L]

Claiming a separate autosegmental tier, the Register Feature partitions the whole range of the voice pitch into two equal portions, a [+upper] portion and a [-upper] one. On Chao's five-level scale, [+upper] covers a pitch range from 5 to 3, and [-upper] from 3 to 1. Each of the two portions, in turn, is divided into two sub-portions by the Tonal Feature [high]. Thus, in terms of coverage of the pitch range, these two features overlap each other. Yip cited a number of cases from

Mandarin to motivate her Register Feature analysis. In this paper, I will focus on her analysis of the Mandarin neutral tone.

2. MANDARIN NEUTRAL TONE: AN INTRODUCTION

First, let me give a brief introduction to the general characteristics of the neutral tone in Mandarin. In the literature, a syllable with the Mandarin neutral tone has been described as toneless or atonic (Dow 1972), or pitchless (Li and Thompson 1981). It is said to be short and light (Xu 1983), and short and lax (Cheng 1973). Based on earlier acoustic studies by Zadoenko (1958) and Dreher and Lee (1966), Cheng concludes that "the length of a neutral tone syllable is about one half that of a full tone syllable (p. 55)."

The neutral tone has been observed to be related to no stress or lack of stress. Being the first person using the term "neutral tone" for the tone in question, Chao (1968), for instance, indicates his belief in a connection between the two by placing the discussion of the neutral tone in the section entitled "Weak Stress" in his book. In this study, Chao also remarks that "in weak stress, the tone range is flattened to practically zero and the duration is relatively short (p. 35)."

The connection between the neutral tone and lack of stress is also expressed in Li and Thompson (1981). According to these authors, "if a syllable has a weak stress or is unstressed, it loses its contrastive, relative pitch and therefore does not have one of the four tones. In such a case, the syllable is said to have a neutral tone (p. 9)." In still another study, the neutral tone and weak stress are not even distinguished. Xu writes in his 1983 paper that "the neutral tone is also called weak stress. It is pronounced with the characteristics of being light and short (p. 220)." To establish a cause-effect relationship between the neutral tone and stress, Cheng (1973) maintains that the neutral tone is derived from lack of stress. According to him, "when a syllable is stressed, it has a tone, but when it is unstressed, its tone becomes neutral (p.57)." Therefore, he continues, "the neutral tone items must be specified with full tones in the lexicon (p. 66).[1]"

Still another fact concerning the neutral tone is that almost all morphemes that appear in the neutral-tone shape have also a corresponding full-toned form found in a stressed position. This fact indicates that the neutral tones in these morphemes are each derived from their respective full tones in a non-stressed or weak-stressed position. There are, however, a handful of exceptions (less than ten), and these include the frequent grammatical particles such as the perfective particle *le*, the possessive particle *de*, and the continuous-aspect particle *zhe*.[2] These particles are always in the neutral tone form, and their exact full-tone correspondences are hard to trace from a synchronic point of view.[3]

What then is the shape of the neutral tone in phonetic or phonological terms? According to Chao (1968), the neutral tone does not have a phonemic tone shape (or pitch value) of its own; rather, it derives its pitch value from the tone that precedes it. When following other tones, for instance, its pitch value varies with the pitch values of the end points of the preceding tones.

Having given a general introduction to the neutral tone, let us examine Yip's analysis of it.

3. YIP'S ANALYSIS OF THE NEUTRAL TONE

Yip indicated that the neutral tone (Tone 0) provides evidence for the autonomous status of the [upper] feature, and therefore justification for its postulation. Specifically, she argues that this Mandarin tone, when appearing on the handful of grammatical particles just mentioned, is prespecified for its Register Feature [upper], but not for its Tonal Feature [high]. Namely, it consists of the following underlying representation:

(2) [-upper]

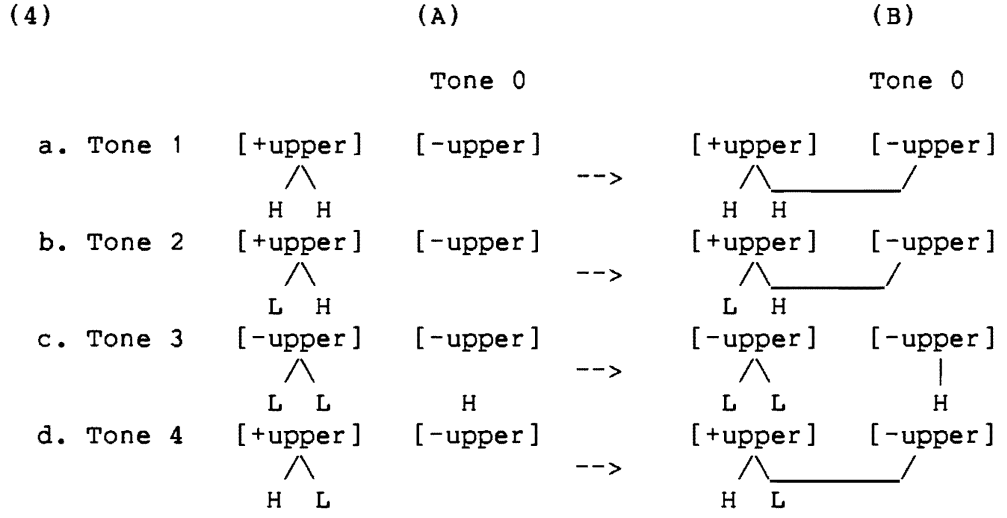
Yip's analysis for the neutral tone is based on the following data (Yip, p.47 and p. 163).[4]

(3)

	Tone 0
Tone 1 (55)	3
Tone 2 (35)	3
Tone 3 (21)	4
Tone 4 (53)	1

These data indicate specifically that the neutral tone has a middle-level pitch after Tone 1 and Tone 2, and a low pitch after Tone 4, but a relatively high pitch after Tone 3. If Chao is right in considering that the value of the neutral tone is derived from its preceding tone, what then are the derivational processes involved? According to Yip, the derivations are done in the following manner:

(4)



First, in each case, the neutral-toned morpheme shows up with its prespecified feature [-upper] after the concatenation of the two relevant morphemes. Then, spreading occurs through which the neutral tone acquires the value of its Tonal Feature from its preceding tone. Such an analysis works well in the cases of Tones 1, 2 and 4, but fails to work for the neutral tone following Tone 3. Yip's solution for this problem is "a special rule that inserts a H tone after the third tone when no other tone follows (Yip, p. 162)." Yip explains that by "no other tone follows", she means "pre-pausally or before a neutral tone (p.162)". Namely, a rule in the following shape:

(5) LL --> LLH / ___ pause or a neutral tone

4. THE PROBLEMS

4.1. Prepausal Position and the Neutral Tone

First, there seems to be a minor problem with Yip's treating the neutral on an equal footing with the pre-pausal position. While it seems quite natural to consider a pause as a case of "no other tone follows", it is not exactly clear whether the neutral tone can be similarly considered. In other words, it is not clear how a syllable, though in the neutral tone, can function just like a pause. Arguably, the appearance of an extra toneme in the third tone before a pause may be due to that there being "room" for its appearance. The pre-pausal position is after all a common place where extrametrical and idiosyncratic materials do occur to "take shelter" from rigid phonological rules. No such "room" or shelter-type function, however, can be found before another syllable, neutral-toned or otherwise.

From another viewpoint, if the occurrence of an extra toneme is to achieve a growth in length in the third tone so that it may realize its potential full length, it is odd that no such tendency toward an increase in length is seen in the pre-neutral-tone position. A research finding made in Dreher and Lee (1966) shows that the tone before the neutral one is shorter than it is before other tones. According to these authors, tones immediately preceding the neutral tone are about 20 percent shorter than usual.

The conclusion to be drawn from the above discussion is that there is no bona fide reason for the insertion of a H toneme in that specific position (see (4c)). It should be noted, however, that this problem in Yip's analysis does not constitute a sufficient argument to reject her analysis. That argument comes from the fact that Yip's analysis of the neutral tone fails to capture an important generalization about the neutral tone.

4.2. The Neutral Tone after the Third Tone

As mentioned earlier, Chao (1930, 1968) believed that the neutral tone does not have its own inherent pitch value, but acquires its surface value from its preceding tone. Chao's observation is true to a certain extent. The proposed assimilation (or spreading, shown in column B of (4)) does indeed occur to produce the precise surface pitch forms. The question is: how can one account for these precise pitch values? Or, is there any generalization hidden among these phonetic surface values?

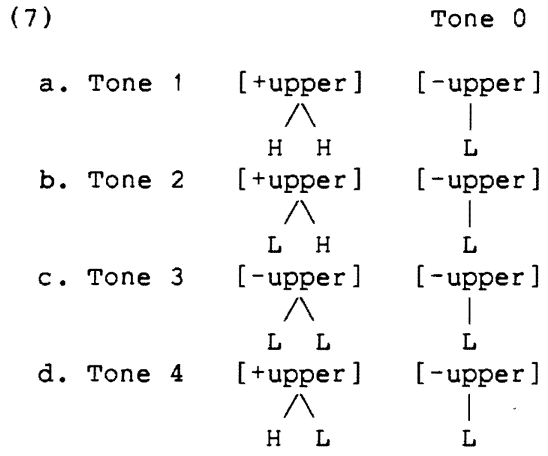
The answer to the latter question is yes.[5] Now, let us have another look at Yip's data provided earlier in (3).

(6)

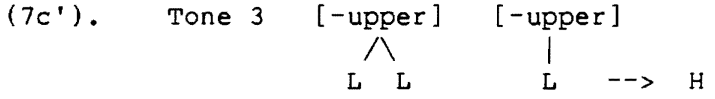
		Tone 0
Tone 1	(55)	3
Tone 2	(35)	3
Tone 3	(21)	4
Tone 4	(53)	1

One observation that can be made about these data is that the differences in pitch value between the endpoints of Tones 1, 2 and 4 and that of the following neutral tone all equal 2: in all three cases, the pitch of the neutral tone is 2 points lower than the endpoint of its preceding tone, measured on Chao's scale. However, the difference in value between the neutral tone and its preceding Tone 3 is a positive 3, (if the number 2 just mentioned is regarded as being negative). The question is: why does the neutral tone behave differently when following the third tone?

The answer clearly lies in the distinct form of the third tone as opposed to the forms of the other three phonemic tones: it is the only low tone and the only tone that reaches the lowest pitch before the neutral tone. This fact does not seem to matter much when one tries to relate it to the precise phonetic values of the neutral tone. But suppose the neutral tone is represented as a fully specified low tone in the underlying representation, the situation would look more obvious. This can actually be illustrated in Yip's analysis.



One thing that becomes readily observable from such a configuration is the total identity between the shape of the neutral tone and the endpoint of its preceding Tone 3 (c). notice that the same identity is not found in the other cases. Under such an analysis, the mystery about the odd behavior of the third tone is resolved: the identity triggers a dissimilation process which raises the neutral tone after Tone 3 in pitch. Namely,



With the above generalization captured, it becomes now easy to account for the other values of the neutral tone. Clearly, the higher surface values of the neutral tone after Tone 1 and Tone 2 are due to a lower level phonetic co-articulation, as described in Shen (1990). Specifically, the value of the neutral tone is raised to 3 simply because Tones 1 and 2 that precede it are both tones ending in high tonemes. It is not after Tone 4, because Tone 4 ends in a relatively lower toneme.

It should be noted that it takes the identity in both tiers to trigger the dissimilation process described in (7c'), as a similar process is not found in the case of Tone 4 where there is no match between the two Register-Feature specifications in spite of the fact that there is identity at the

Tonal tier. If this observation is correct, it should serve to indicate that the neutral tone cannot be an underspecified tone, but just a plain low tone (probably 1 in pitch value), and that the neutral tone case does not constitute an argument for the autonomous behavior of the proposed Register Feature.

4.3. The Neutral Tone on Post-Verb Syllables

Another related piece of Mandarin evidence Yip cited to motivate the Register Feature [upper] and its autosegmental behavior comes from the following data (Yip, p. 63 & p. 175):

(8)

mai(4)	"sell"		song(4)	"deliver"
shang(4)	"up"		qu(4)	"go, to"
le	"perfective particle"			

a. mai(4) le. "sold; have been sold"

b. song(4) shang(4) qu(4). "deliver up (to)"

c. song(4) shang(4) qu(4) le. "delivered up (to)"

where (4) = Tone 4

One characteristic concerning the above three sentences is that all of the syllables after the main verbs *mai(4)* and *song(4)* receive weak stress, and the stress pattern can be roughly shown as follows:

(9)

a.
s	w
mai(4)	le.

"sold; have been sold"

b.
s	w	w
song(4)	shang(4)	qu(4).

"deliver up(to)"

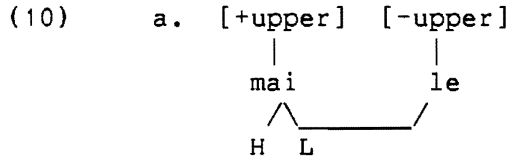
c.
s	w	w	w
song(4)	shang(4)	qu(4)	le.

"delivered up(to)"

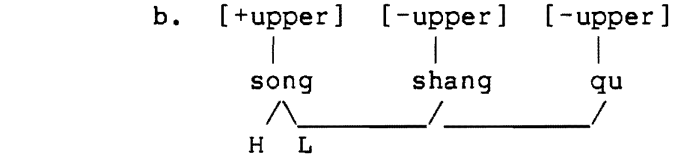
where s=strong and w=weak

Namely, the main verb in each case is stressed while the rest of the syllables are not (or have weak stress). In addition, these post-verb syllables may be regarded as carrying the neutral tone,[6] although the source of the neutral tone on *le* is different from that of the neutral tones on the rest of the post-verb syllables. The former is underlyingly a neutral tone (signalled by the absence of any tonal diacritic); it is a neutral tone before syntactic concatenation. The latter, however, are underlyingly full-toned, derived through a lack of syntactic stress. In general, all the syllables after the verb are perceived as rather low in tonal value. Now let us see how Yip interprets the data as a support for the postulation of the Register Feature:

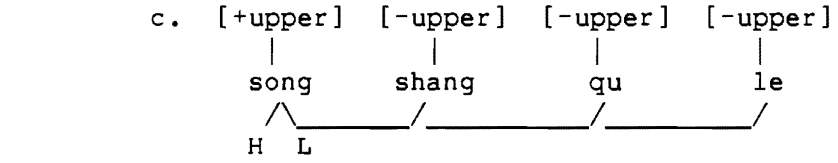
(10) a.



b.



c.



Assuming that all the neutral toned syllables are prespecified as [-upper] for the Register Feature, Yip adopts a spreading analysis whereby all the post-verb syllables acquire their low tonal value through the spreading to them of the Tonal Feature L ([-high]) from the preceding verb.

First, there is a minor problem regarding this analysis: while Yip is explicit about the source of the feature [-upper] on the syllable *le* (one of those few syllables in Mandarin which are always neutral-toned; see also the last section for relevant details), she does not explain how [-upper] gets there for the rest of the post-verb syllables. However, this problem is probably not difficult to work out; it appears to be just a technical problem which needs to be worked out in detail. Therefore, I will dwell no further on it.

The major problem with this analysis lies in its violation of the locality requirement implicit in the observation that the neutral tone derives its tonal value from its preceding tone. Although the neutral tone has been reported to derive its phonetic surface value through spreading from its immediately preceding tone, no studies have found this spreading to go beyond its immediately following tone. This problem does not show much in Yip's analysis (10) of the sentences in (8), since this analysis does yield the grammatical result of a low tone on these post-verb syllables. The problem is better shown if Yip's data are expanded to include the following sentences:

(11)

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tai(2)    "carry"
tui(1)    "push"

a. tai(2) shang qu le     "carried up"
b. tui(1) shang qu le     "pushed up"

   where (2) = Tone 2
         (1) = Tone 1
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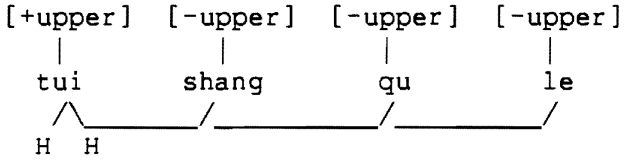
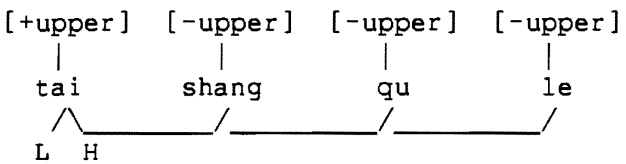
Notice that in Yip's earlier data, all the main verbs are by chance in the fourth tone (i.e. (53) according to Yip). These two sentences here are identical to her sentence in (8c) in every other

aspects except for the tonal values of the main verbs at the beginning of the sentences. Here in (b), the verb *tui* carries the first tone (55), while in (a), the verb *tai* is in the second tone (35), both being tones ending in high tonemes. Based on Yip's earlier treatment, the neutral-toned, post-verb syllables in these two sentences should acquire their tonal value through prespecification and then spreading as shown below:

(12) * a.

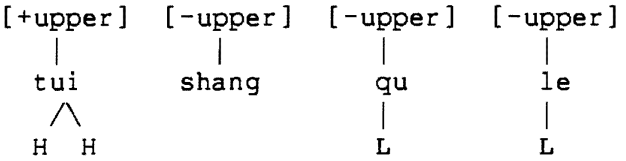


* b.

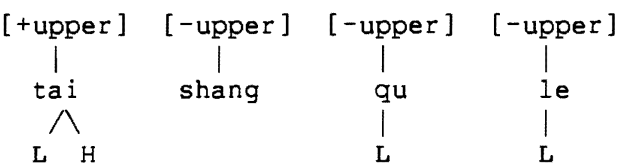


While the results in (10) may by chance be grammatical, the results here with all the neutral-toned syllables having a value at the middle range (i.e [-upper, H]) are clearly unacceptable. Although this value (i.e [-upper, H]) may be accepted for the syllable IMMEDIATELY following the verb as a low-level phonetic surface representation, it can by no means be accepted for the two tones that follow. The right output for these two tones should be just as the post-verb tones in the earlier cases in (10):

(13) a.



b.



The problem involved is this: the spreading will not go beyond its adjacent tone, if there is indeed a spreading of the Tonal Feature from the preceding tone. From this follows another problem: if the two final syllables do not receive their Tonal Feature specification from the main verb, where can they acquire that feature specification? Or, how exactly can they surface fully specified? It is not clear how these questions can be answered in Yip's analysis. The problem of the source of the Tonal Feature specification shows up even more obviously in another sentence of the same type:

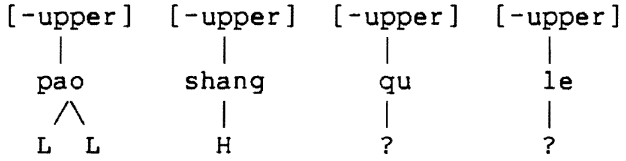
(14)

pao(3) "run"
pao(3) shang qu le "ran up"

where (3) = Tone 3

This sentence is once again identical to Yip's sentence in (8c) in every respect except for the tonal value of the main verb. The difference is that there, the verb is fourth-toned (53), but here the verb is third-toned (213). Now a serious problem arises in the acquisition of the Tonal Feature specification on the part of the post-verb syllables. Let us observe the following:

(15)



Recall that in Yip, the neutral tone immediately after the third tone acquires its Tonal Feature specification by way of the following rule (cf. (5)).

(16) LL --> LLH / ___ pause or a neutral tone

What this rule says is that a Tone 3 (213), represented as [-upper] LL, acquires a H tone when preceding a neutral tone or a pause. If the locality requirement on the spreading of the tonal value from a preceding tone to its adjacent following neutral tone is not obvious in the previous cases in (8) and (11), it should be quite explicit by virtue of this rule that the only neutral tone that is affected is the one IMMEDIATELY after the verb. However, although this rule is right in correctly encoding the adjacency requirement, it also reveals a problem in Yip's treatment of the type of sentences in question. The problem is: how can one account for the tonal values of the two syllables that are not adjacent to the verb? It is not clear how this difficulty can be easily surmounted. It would seem rather unnatural if more rules should be devised to insert more H tones for the two words *qu* and *le* at the end of the sentence. Even if these H tones can, by some perhaps unnatural means, be created for the two syllables, the resultant sentence is ungrammatical anyway. This is because the last two syllables again do not occur as a middle tone [-upper, H], but rather as a low tone, specifiable in terms of [-upper, L].

By now, it should be clear that Yip's analysis for the post-verb tones under discussion is not adequate, and that it has not succeeded in demonstrating that the autonomous Register Feature is supported through this analysis. This case of the tones on the post-verb syllables provides further evidence to show the implausibility of Yip's analysis for the neutral tone discussed in the last section. Among other problems, it cannot account for the surface tonal shape of a neutral-toned syllable found after another neutral tone. And, this case provides further evidence that the neutral tone should be fully specified before the low-level assimilation takes place.

NOTES

1 See Chen (1984) for a different view.

2 The names or the exact syntactic functions of these particles may be controversial. However, the controversy should not affect the present discussion.

3 Diachronically, though, they have been found to be derived from full-toned morphemes (Cheng, p.65).

4 She does not mention the source of her data here. Presumably they are from Qi (1956), since they are identical with those of Qi's. The data are almost identical to Chao's as well, which are given below (Chao 1968, p.36):

	Tone 0	
Tone 1	(55)	2
Tone 2	(35)	3
Tone 3	(213)	4
Tone 4	(51)	1

The only difference between Chao and Yip's data shows up on the neutral tone after Tone 1. In Chao it is measured at 2 while in Yip's citation, it appears as 3. I believe the difference is trivial and therefore negligible.

Notice also that in (3), Tone 3 is represented with a value of (21) rather than (213). The examples shown there are mine.

5 For a more detailed discussion and justification of the existence of this generalization and an alternative analysis of the Mandarin neutral tone, the reader is referred to Lin (1992, Chapter 6).

6 I would not be surprised if there are researchers who do not agree with treating them all as identical neutral toned syllables. In fact, my intuitive feeling is that these post-verb syllables (except *le*) still carry distinct though reduced tones, the reduction being due to lack of stress, and no matter how much tone modification occurs in each case, these syllables are not produced with an exactly identical contour or pitch. However, this perception may be purely phonetic in nature. Namely, phonologically, these tones may very well be considered to be the same neutral tone.

REFERENCES

Bao, Zhi-ming (1990). *On the nature of tone sandhi.* Doctoral Dissertation, MIT.

Chao, Yuen Ren (1930). A system of tone letters. *Le Maitre Phonetique,* 30:24-27.

Chao, Yuen Ren (1968). *A grammar of spoken Chinese.* Berkeley, California: University of California Press.

Chen, Chung-yu (1989). Lexical diffusion of a tonal change in reduplicates and its implications. *Journal of Chinese Linguistics,* 17:96-127.

Cheng, Chin-chuan (1973). *A synchronic phonology of Mandarin Chinese.* The Hague: Mouton.

Dow, Francis D. M. (1972). *An outline of Mandarin phonetics*. Canberra: Australia National University Press.

Dreher, John and Pao-ch'en Lee (1966). *Instrumental investigation of single and paired Mandarin tonemes*. Douglas Advanced Research Laboratory.

Li, Charles N. and Sandra A. Thompson (1981). *Mandarin Chinese: A functional reference grammar*. Berkeley: University of California Press.

Lin, Hua (1992). *On The Nature of Mandarin Tone and Tone Sandhi*. Doctoral Dissertation, University of Victoria.

Packard, Jerome L. (1989). Register in Chinese tonal phonology. In Marjorie Chan and Thomas Ernst, (eds.), *Proceedings of the Third Ohio State University Conference on Chinese Linguistics*, 13-14 May, 1988, pp.18-36. Reproduced by Indiana University Linguistics Club.

Pulleyblank, D. (1986). *Tone in lexical phonology*. Dordrecht: Reidel.

Qi, Sheng-qiao (1956). Hanyu de zidiao, tingdun yu yudiao de jiaohu guanxi, [the interaction among Chinese tones, pauses and intonations]. *Zhongguo Yuwen*, 10:10-12.

Shen, Susan Xiao-nan (1990). Tonal Co-articulation in Mandarin, *Journal of Phonetics*, 18:281-295.

Shih, Chi-lin (1986). *The prosodic domain of tone sandhi in Chinese*. Doctoral Dissertation, University of California at San Diego.

Xu, Shu (1983). Qingsheng de zuoyong, [The functions of the neutral tone]. In Zheng-kun Wang, Wen-qing Xie, and Zhen-duo Liu, (eds.), *Yuyanxue Ziliao Xuanbian*, [Selected materials on linguistics], pp. 220-224.

Yip, Moira (1980). *Tonal phonology of Chinese*. Doctoral Dissertation, MIT.

Yip, Moira (1989a). Tone contours as melodic units: evidence from Wuxi. In Marjorie Chan and Thomas Ernst, (eds.), *Proceedings of the Third Ohio State University Conference on Chinese Linguistics*, 13-14 May, 1988, pp.37-53. Reproduced by Indiana University Linguistics Club.

Yip, Moira (1989b). Contour tones. *Phonology*, 6:149-174.

Zadoenko, T. P. (1958). Hanyu ruodu yinjie he qingsheng de shiyan yanjiu, [An experiment on the weak-stressed syllables and the neutral tone in Chinese]. *Zhongguo Yuwen*, 78:581-587.

Zee, Eric (1991). Tone feature system and Shanghai tone. Paper presented at *the Third North American Conference on Chinese Linguistics*, May 3 - 5, 1991, Cornell University.