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Author(s): Deborah S. Davison
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Deborah S. Davison
San Jose State University

Introduction

Pulleyblank 1986 proposes that languages vary parametrically as to whether tonally underspecified skeletal slots link autosegmentally via spreading from neighboring tones or are filled in by default tone values. In his analysis default tone association applies non-cyclically at the post-lexical level at the earliest in Margi, Tonga, and Tiv and at the phonetic level in Yoruba. He argues that two-tone systems such as Tiv and Margi have a default low [-upper] tone assigned by Universal Grammar in the post-lexical phonology, whereas three-tone systems such as Yoruba and Yala have a default mid [-upper], [+raised] tone assigned by UG in the phonetic component. Pulleyblank, after Liberman 1983, differentiates the phonological and phonetic rules as follows: (i) phonological rules are restricted to binary use of features, phonetic rules are gradient; (ii) the number of phonological entities is bounded, of phonetic entities unbounded; (iii) the consequences of phonetic rules often involve temporal structure and coordination; and (iv) phonetic rules cannot have lexically-conditioned exceptions.

Keating 1990 and others further distinguish phonological assimilation, in which a segment acquires the feature value of a neighboring segment (and by implication also default tone assignment, in which a default tone is assigned late in the derivation,) from phonetic assimilation, in which a segment's value for a particular feature is partial and/or gradient and transitional. In the latter case pitch values derived by phonetic assimilation may result from interpolation through a featurally unspecified span. In Keating's model the output from the phonological component need not be fully featurally specified before being input to the phonetic component. In consideration of the above, four options are conceivable for tonally underspecified morphemes: tone is acquired by phonological spreading, by default tone assignment in the phonological or phonetic component, or by phonetic spreading.

Evidence of phonological assimilation of tones (tone spreading) has been presented for Mexican and African tone languages (cf. Clements and Goldsmith 1984, Goldsmith 1990), as well as Southeast Asian languages (Morse 1988, Delancey 1989, Mazaudon and Michailovsky 1989), and Southern Chinese Min (Chan 1984), Cantonese (Yip 1980), and Southeast Mandarin Danyang and Jin Mandarin Changzhi dialects (Davison 1989). Analyses of default tone association in East Asian languages include Wright 1983 and Davison 1989.

Phonetic assimilation of tones, evidenced by interpolation of pitch values across tonally unspecified syllables, is attested in Tibetan (Mazaudon, pc). Long-distance phonetic interpolation between tonal targets, not phonological spreading, also has been described for pitch assignment to noun phrases in Shanghainese and Wuxi (Zee and Maddieson 1979, Chan and Ren 1986), as well as other Wu Chinese dialects.

In Mandarin Chinese, most syllables are underlyingly fully specified for tone, and thus the contexts available for tone spreading are relatively few. The most obvious exceptions are so-called `neutral tone´ morphemes or syllables, stressless syllables of words and phrases which lack a lexically contrastive tone. Pitch realization on these syllables has been the object of intensive research, as reviewed below.

In the present study, pitch contours extracted from spectrographic measurements of controlled data samples of non-phrase-final stressless syllables pronounced by Northern Mandarin (NM) and Taiwanese Mandarin (TM) speakers are compared. The data suggest that Taiwanese Mandarin speakers assign pitch to underlyingly toneless syllables by phonetic interpolation from a mid tone value (cf. Wright 1983´s identification of mid tone as the default tone for Amoy and Chaozhou Min Chinese dialects). The Taiwanese Mandarin mid tone generally is timed to occur early in the toneless syllable (at the leftmost edge), after which the pitch either may decline, or, less often, interpolate in the direction of the immediately following tone (this phenomenon also occurs with one of the NM speakers, see (9iiia)). The choice between the latter two options appears to involve syntactic conditioning (compare (9viii) with (9iiia) and (9vii) and see also Davison 1992), suggesting that in Taiwanese Mandarin default tone assignment is postlexical.

For the same set of examples in Northern Mandarin, non-phrase-final, underlyingly stressless syllables between preceding high, following low tones are observed instrumentally to receive pitch assignment by smoothing functions between the pitch values of the surrounding tones, without reference to a tonal target (cf. (9xii) below, where a H-0-L pattern shows the stressless syllable´s pitch ending lower than the following syllable´s low target in TM, but mid, interpolated between the preceding H and following L, in NM).

In addition, a stressless syllable receives a high pitch by spreading and/or reassociation of the high of a preceding high rising (MH) tone (Mandarin tone two) followed by a low tone (Mandarin tone three) in NM, not in TM (cf. (9xi) below as well as a similar phenomenon reported for Tianjin (Northern) Mandarin in Davison 1991). The latter process may be understood as a phonetically motivated redistribution of the two (mid plus high) tonal targets of the first syllable, resulting in the mid tone being associated to the original tone two syllable and the high tone to the underlyingly toneless syllable. Tone four HL could be analyzed in similar fashion.

Other differences between NM and TM are that the stressless syllable surfaces with a low pitch between two highs in NM, rather than the mid pitch of TM (9a). Also, in two of three NM speakers, in 5/6 examples, a stressless syllable preceding a low tone three is realized as a low-rising + low (LH+L) tone contour (compare (9iv) with (9v) and (9xii)). Only one TM speaker of four, out of a total of seven examples, shows this pattern. The latter phonetic rule closely resembles the (pan-) Mandarin lexical tone sandhi rule dissimilating a sequence of low third tones to a rising plus low tone.

In sum, then, the NM pitch assignment rule appears to be considerably more complex than that for TM. Between high tones and a preceding low tone three a default low tone is apparent; moreover, in the latter case, it is variably subject to low tone dissimilation. Elsewhere there is evidence of phonetic interpolation across the stressless syllable or autosegmental spreading of preceding tones onto it. The differences between the two dialect groups suggest that TM assigns a default mid tone to lexically underspecified syllables post-lexically, whereas in NM tonally underspecified syllables enter the phonetic component as such. Low default tone assignment is then presumably the last of several options available for surface realization of pitch on these syllables, and it itself feeds phonetic low tone dissimilation, suggesting the need for ordering of default low tone insertion before dissimilation in the phonetic component of the grammar.

Compared to Pulleyblank's results in which default mid tone is found in three tone systems, low in two tone systems, we find differences in default tone value, mid vs. low, and conditioning, absolute vs. gradient, across two mutually intelligible varieties of Mandarin dialect, both with four lexical tones. The evidence from these dialects thus suggests default tone assignment in Chinese.

Before proceeding to a review of previous work let us briefly summarize the Mandarin neutral tone facts and exemplify one aspect of the TM/NM difference described above. Recall that the traditional manner of tone contour description assigns 5 to high, 1 to low pitch. Mandarin's four lexical tones thus are describable as T1 55 high level, T2 35 high rising, T3 214 low dipping, and T4 41 falling. Example (1) shows the four lexical tones of Mandarin and pronunciation of following toneless, stressless syllables before pause. Sources vary as to details while agreeing on the overall resulting contours.

(1) Mandarin disyllabic words illustrating lexical tones 1-4 followed by neutral \`0' (stressless, toneless) syllables (tone values are according to Chao 1948:27)

(a) Tone 1 (T1) high level + half-low tones: **ta1+de0** \`his'
(b) T2 mid-to-high rising + mid tones: **shui2+de0** \`whose'
(c) T3 low level + half-high tones: **ni3+de0** \`yours'
(d) T4 falling + low tones: **da4+de0** \`big ones'

(2a) illustrates the fact that a Taiwanese Mandarin toneless syllable between two high tone words has a high-mid-high pattern, with a noticeable dip in the fundamental frequency over the middle, stressless syllable. The same sequence rendered by a Northern Mandarin speaker has an even more pronounced high-low-high pattern, as in (2b), see (9a). These data serve to support the interpretation that the two Mandarin-speaking groups differ parametrically regarding the assignment of pitch values to toneless syllables.

(2) Pitch realization on stressless syllables between two high tones (H=high tone, M=mid tone, L=low tone)

(a) Taiwanese Mandarin (TM) **dingl+zi0 dil** `[the] nail [is] low'
H M H

(b) Northern Mandarin (NM) **dingl+zi0 dil** `[the] nail [is] low'
H L H

Most Taiwanese Mandarin speakers also speak Taiwanese Min, a Southern Min dialect similar to the mainland dialect of Amoy. Amoy is identified by Wright 1983 as having a default mid tone value. Assuming Taiwanese Min also has a default mid tone value, the results of the present study may be interpreted as showing that Taiwanese Mandarin speakers utilize a single parametric rule assigning default mid tone to stressless syllables for both languages, i.e. for Taiwanese Southern Min and Taiwanese Mandarin.

1. Previous studies of Mandarin neutral tone realization

Mandarin stressless, toneless syllables, also known as `neutral tone syllables', occur as rightmost syllables of disyllabic words or morphemes, either lexically marked as such or morphologically derived by cliticization or reduplication, according to Woo 1969. Realization of pitch contour on lexically marked toneless syllables has been interpreted by some researchers as resulting from default register assignment combined with tonal spreading (Yip 1980) and by others as (in our terms) phonetic interpolation between the tones of neighboring syllables (Shen 1989:40, Woo 1969, Chao 1956:53). Here we have space to review only the work of Yip 1980.

Yip 1980 was concerned to show that evidence in support of autosegmental phonology drawn from African languages also could be found in languages such as Chinese. Yip argued that neutral tone following tones 1 and 2 acquired high tones and neutral tone following tone 4 acquire low tone from the preceding syllable, by means of autosegmental spreading; whereas tone 3 inserted a high tone onto the following neutral tone. This is summarized in (3).

In order to derive the required mid tone value on neutral tones following tones 1 and 2 Yip proposes that the neutral tone syllables, while underspecified for tone, have underlying low register. This approach accomodates the TM but not the NM results summarized above, presented below.

(3) Yip 1980, autosegmental analysis of neutral tone pitch assignment in Mandarin (H=high tone, L=low tone). The surface mid tone value on neutral tone following T1 and T2 results from the interaction of H Tone Spreading with the neutral tone syllable's low register.

(a) T1 55 H	**ma1+de0**	`mother's'	H Tone Spreading
	H		
(b) T2 35 MH	**ma2+de0**	`hemp's'	H Tone Spreading
	MH		
(c) T3 214 L H	**ma3de0**	`horse's'	Floating Tone Assoc.
	L H		
(d) T4 41 HL	**ma4de0**	`angered'	L Tone Spreading
	HL		

In this paper we refer to the models of lexical phonology of Pulleyblank 1986and of phonetic interpolation in context of phonetic underspecification of Keating 1988 et al. to characterize parametric variation in the realization of TM and NM. Keating suggests that in a phonology allowing surface underspecification, a segment may exit the phonology with no value for a feature, having failed to receive one either lexically or by later rule. The segment, transparent in the phonetics to any rule sensitive to that feature, thus cannot be assigned a quantitative target. When phonetic rules build trajectories between segments, the unspecified segment contributes nothing to its own trajectory, permitting its neighbors to interact with each other, such as by interpolating values for the unspecified feature across the transparent segment, joining immediately preceding and following targets.

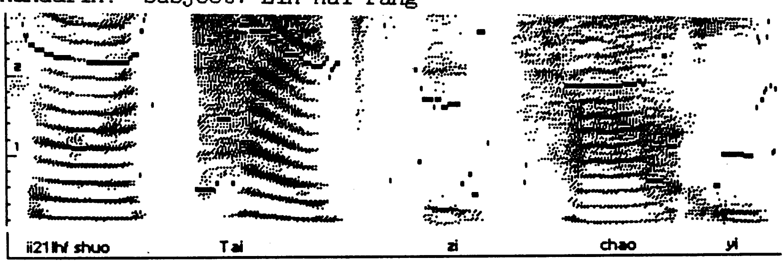
2. Method and analysis of the present study

For this paper a sample of contextually controlled sentences containing the Mandarin stressless, toneless nominalizing suffix **zi** was analyzed spectrographically. The data exemplified in (8) were elicited from five Mandarin speaking natives of Taiwan and three Mandarin speakers from various areas in North China. All are college-educated graduate students or faculty of San Jose State University.[1] Speakers were asked to read a corpus of one hundred sentences as slowly as possible while maintaining natural intonation. The slow speed was to ensure that stressless syllables would be sufficient large in amplitude and duration as to be visible without distortion using the pitch extraction algorithm of the analysis software, the Ariel Sensimetrics Speechstation.

Of the one hundred sentences, fifteen contained the **zi** suffix. These were repeated twice and distributed randomly throughout the corpus. Thus a total of 30 **zi** suffix tokens for each speaker were elicited. All sentences analyzed for this study included a target noun phrase containing the toneless syllable **zi**, embedded in the carrier sentence **Qing ni zai shuo __ yici** `please repeat __ once/twice/thrice again'

Detailed comparisons were made of duration of and pitch variation across the toneless syllable, measured from narrow band spectrograms and a superimposed pitch track traced onto the tenth harmonic. A sample analyzed token appears in (4).

(4) Spectrograms with superimposed pitch tracing of the tenth harmonic. Neutral tone between stressed syllables in Taiwanese Mandarin. Subject: Lin Hui Fang



`...say `Prince's dynasty' one time.' Tones:T1H 4HL 0 2MH 1H 4HL.

Keating's distinction between phonological spreading and phonetic interpolation to underspecified segments may be applied to the question of pitch assignment to neutral tone syllables in Mandarin. Interpolation across a toneless syllable located between two stressed H or L tones or between HL and LH tones might be expected to look like the graphs in (5). The dotted line indicates an interpolated pitch value between target values of preceding and following syllables. Notice that it would be impossible to distinguish between interpolation or spreading applying between like tones: HH or LL. In either case the pitch contour would be flat. The crucial cases would rather be HL and LH. A spreading tone would be expected to show a steep slope over the neutral tone syllable, rather than a gradual one as in (5c-d).

(5) Phonetic interpolation between tonal targets of adjacent stressed syllables (idealization)

(a) High tone - neutral - high (b) Low tone - neutral - low

(c) High tone - neutral - low   (d) Low tone - neutral - high

Returning to an analysis of the data in (7), summarized in (6), we see that for TM, a mid to low falling contour typifies stressless syllable realizations between all tone height combinations, with the exception of cases of random individual variation noted above, as well as in certain contexts involving a preceding T3.[2] As Yip and others have argued, Mandarin T3 is well analyzed as an underlying low plus a floating high tone, as in (3c) above. According to these data, in TM, just in case a T3 is followed by a toneless syllable followed by a high tone, T3's floating H may be timed to surface either late in the stressless syllable, giving a L-LM-H or L-LH-H pattern, or throughout the toneless syllable, giving the L-H-H pattern. In contrast, in the L-0-L pattern in (7bv), preceding and following T3s result in the leftmost T3's floating high tone to be realized as mid-falling tone, like TM stressless syllables following all tones other than T3. TM thus could be described as assigning a default mid tone postlexically to stressless syllables, generally timed to occur early in the syllable, after which the pitch typically declines (postlexically, as noted above, because of evidence of the influence that the type of interpolation, either from the left or between left and right targets, depends partially on syntactic bracketing, cf. Davison 1992).

In contrast, NM speakers may be described as leaving stressless syllables underspecified until they exit the phonological component. In the phonetic component autosegmental spreading from a preceding high rising T2 applies optionally and gradiently. Between low and high targets interpolation of the sort predicted by Keating's model is an option. Otherwise, a default low tone is realized, which in turn may be subject to low tone dissimilation, as noted above.

One final point of difference, not previously mentioned, is that NM speakers in this corpus always render T3 low + floating high as L-LH. TM speakers, on the other hand, apparently are not as constrained as to timing of the H in the stressless syllable. This would appear to raise the possibility for NM but not for TM that T3 is underlyingly LLH, as some analysts recently have described it, and that its contour is realized less variably than previously thought. Notice that if NM T3 is understood as a superlong low level plus low rising tone, then its surface manifestations (`allotones') could be analyzed as being the realization of one or the other half of or alternatively all of underlying form: all in the case of prepausal position (214); the second half (14) over stressless syllables and preceding another T3; and the first half elsewhere.

(6) Summary, parametric differences between TM and NM pitch realization on non-phrase-final stressless syllables

	TM	NM
HOH	H-ML-H	H-HL-H~H-ML-H~H-LH-H~H-H-H
HOL	H-ML-L	H-M-L~H-HM-L~H-LH-L

LOH 1st syl. T4:	HL-ML-H~HM-ML-H	HM-ML-H
1st syl. T3:	L-LM-H~L-LH-H~L-H-H	L-LH-H
LOL	L-ML-L*	L-LH-L*

*excluding example (9iv), see fn 3.

(7) Duration and fundamental frequency at pitch turning points for nominal suffix **zi** and immediately preceding and following syllable, for 10 speakers. TM = Taiwanese Mandarin speakers (subjects LHF, LZC, GMH, PLD, XGC, LZC), NM = Northern Mandarin speakers (subjects TF, JL, GG). R=rising pitch, F=falling pitch, L=level pitch, CC=concave pitch, CV=convex pitch. D=duration in milliseconds. (Speakers varied between **fa3+zi0** and **fa2+zi0** pronunciations for the word `method'. Results relevant to each category for this variably pronounced word are in boldface type.)

(a) high - unstressed - high (Ts 101, 104, 201, 204)[3]

i. **Qing3 ni3 zai4 shuo1 ding1+zi0 san1 ci4.** T101
Please you again say `nail' 3 time.

	ding1	**zi0**	**san1**
TM			
LHF	236-232, F4, D137	197-187, F10, D86	222-220, F2, D144
LZC	123-122, F1, D176	119-100, F19, D109	115, L, D211
GMH	248, L, D174	199-144, F55, D78	220-222, R2, D189
PLD	320, L, D138	197-177, F19, D69	259-265, R6, D87
XGC	189-183, F6, D178	134-115, F19, D94	144-140, F4, D128
LZC	222-224, R2, D178	199-195, F4, D61	232-222, F10,D168
NM			
TF	322-294, F28, D244	218-171, F47, D88	294-275, F19,D138
JL	253-275, R22, D259	148-58, F90, D105	238-210, F28,D64
GG	257-253, F4, D273	218-220, R2, D102	238-246, R8, D211

ii. ...**he2+zi0 san1**... `Please repeat `box' three times.' T201

	he2	**zi0**	**san1**
TM			
LHF	214-212, F2, D93	210-207, F3, D78	222-203, 19, D198
LZC	115-122, R7, D220	113-106, F7, D105	114-115, R1, D271
GMH	201-224, R23, D132	201-185, F16, D74	222-214, F8, D172
PLD	203-242, R39, D148	222-214, F8, D81	251-253, R2, D111
XGC	140-164, R24, D219	148-119, F29, D136	148-152, R4, D141
NM			
TF	207-294, R87, D197	255-164, F91, D150	222-220, F2, D139
JL	201-275, R74, D172	164-140, F24, D125	208-195, F13,D83
GG	201-226, R35, D168	113, L D42	226, L D140

iii. ...**he2+zi0 dan4**... `Please repeat `nuclear bomb'.' T204

	he2	**zi0**	**dan4**
TM			
LZC	119-128, R9, D184	121-113, F8, D54	121-111, F10,D122
GMH	197-220, R23, D115	187-179, F8, D54	212-173, F39,D180

PLD	195-261, R66, D99	177-166, F11, D69	263-195, F68,D131	
XGC	134-152, R18, D129	138-119, F19, D86	146-115, F31,D158	
LHF	197-232, R35, D112	185-187, R2, D47	232-191, F40,D241	
NM				
TF	222-300, R78, D199	199-162, F38, D97	275-179, F96,D172	
JL	177-203, R26, D110	189-138, F51, D87	265-154, F111,D259	
GG	234-273, R39, D137	109, L, D39	269-189, F80,D212	

iiia. ...**fa2+zi0 man4**... `Please repeat `the method is slow'.'

TM	**fa2**	**zi0**	**man4**	T204
LZC	133-114, F19, D144	114-125, R11, D100	130-111, F19,D128	
GMH	214-191, F23, D138	234-234, CC0, D198	234-197, F37,D66	
PLD	**189-238, CC49,D149**	**259-228, CC31,D243**	**259-199, F60,D99**	
XGC	142-115, F27, D263	148-164, CC26,D337	166-126, F40,D148	
NM				
TF	**214-302, R88, D168**	**283-265, CC18,D288**	**281-167, F114,D163**	
JL	85-83, F2, D121	197-269, R72, D113	164-146, F18, D275	
GG	**224-250, CC26,D205**	**224-201, F23, D99**	**220-193, CV27,D236**	

(b) low - unstressed - low (T4+0+T3, 303)

iv. ...**tai4+zi0 hao3**... `Please repeat `the prince is fine'.'

TM	**tai4**	**zi0**	**hao3**	T403
LZC	143-114, F29, D185	114-111, F3, D141	104, L, D185	
GMH	265-210, F55, D100	187-208, R21, D130	169-154, F15,D72	
PLD	333-255, F78, D135	199-277, R78, D211	177-191, D14,D381	
XGC	232-154, F78, D177	126-154, R28, D143	111-99, F12, D108	
LHF	263-214, F49, D108	109-113, R4, D37	177-58, F119,D144	
NM				
TF	332-212, F120,D148	208-294, R86, D137	166-136, F30,D140	
JL	304-189, F115,D187	203-277, R74, D113	162-166, R4, D90	
GG	281-207, F74, D186	212-232, R20, D119	103-95, F8, D91	

v. ...**fa3+zi0 hao3**... `Please repeat `the method is fine'.'

TM	**fa3**	**zi0**	**hao3**	T303
LZC	**112-111, F1, D179**	**123-114, F9, D84**	**114-108, F6, D378**	
GMH	**197-173, CC24,D164**	**201-199, F2, D76**	**201-160, F41,D163**	
PLD	228-265, R37, D103	232-220, F12, D57	169-175, CC6,D273	
XGC	**156-126, F30, D234**	**158-128, F30, D182**	**126-101, F25,D188**	
NM				
TF1	224-302, R78, D259	302, L, D54	195-72, F123,D200	
TF	228-285, R57, D137	183-177, F6, D75	189-175,CC6, D273	
JL1	**152-138, CC14,D119**	**246-261, R15, D84**	**72-80, R8, D108**	
JL	**185-140, CC45,D143**	**220-250, R30, D120**	**58-60, R2, D46**	
GG1	220-253, CC33,D236	214-250, R36, D167		
GG	197-244, R47, D215	222-240, R18, D160	208-210, R2, D109	

(c) low - unstressed - high (Ts 301, 304, 401, 404)

vi. ...**fa3+zi0 man4**... `Please repeat `the method is slow'.'

TM	**fa3**	**zi0**	**man4**	T304

LZC	133-114, F19, D144	114-125, R11, D100	130-111, F19,D128
GMH	214-191, F23, D138	234-234, CC0, D198	234-197, F37,D66
PLD	189-238, CC49,D149	259-228, CC31,D243	259-199, F60,D99
XGC	142-115, F27, D263	148-164, CC26,D337	166-126, F40,D148
NM			
TF	214-302, R88, D168	283-265, CC18,D288	281-167, F114,D163
JL	85-83, F2, D121	197-269, R72, D113	164-146, F18, D275
GG	224-250, CC26,D205	224-201, F23, D99	220-193, CV27,D236

vii. ...**tai4+zi0 san1**... `Please repeat `prince' three times.'

TM	**tai4**	**zi0**	**san1** T401
GMH	246-197, F39, D230	148-85, F63, D180	222-220, F2,D134
PLD		302-242,F60, D81	175-207, CC32,D302
XGC	191-128, F63, D205	126-87, F39, D70	150-156, R6,D101
NM			
TF	332-212, F120,D210	173-152, F21, D114	263-250, F13,D189
JL	261-154, F7, D235	115-93, F22, D88	208-210, R2,D209
GG	275-212, F63, D210	197-191, F6, D93	222-220, F2,D180

viii. ..**tai4+zi0 an1**... `Please repeat `the prince is peaceful'.'

TM	**tai4**	**zi0**	**an1** T401
LZC	156-117, F39, D148	121-128, R7, D121	121-126, R5,D205
GMH	250-197, F53, D140	169-152, F17, D70	197-203, R6,D289
PLD	312-234, F78, D135	195-183, F12, D110	366-378, R12,D98
XGC	183-128, F55, D168	115-101, F14, D73	138-154, R16,D207
NM			
TF	320-218, F102,D124	177-152, F23, D96	261-253, F8,D132
JL	271-148, F123,D241	95-91, F4, D69	212-232, R20,D207
GG	292-205, F87, D184	173-113, F60, D96	216-240, R26,D207

ix. ...**tai4+zi0 fan4**...`Please repeat `the prince's food'.'

TM	**tai4**	**zi0**	**fan4** T404
LZC	132-109, F23, D180	111-109, F2, D136	128-111, F17,D128
GMH	244-197, F47, D180	130-87, F43, D89	220-171, F49,D162
PLD	312-242, F70, D149	162-142, F20, D62	265-212, F53,D120
XGC	210-140, F70, D233	125-102, F23, D177	160-111, F49,D174
NM			
TF	310-218, F92, D168	166-154, F12, D79	277-177, F100,D142
JL	322-160, F162,D220	121-107, F14, D105	294-144, F150,D241
GG	302-212, F90, D183	210-193, F17, D115	277-214, F63,D198

(d) high - unstressed - low (Ts 103, 203)

xi. ...**ding1+zi0 liang3**... `Please repeat `nail' two times.'

TM	**ding1**	**zi0**	**liang3** T103
LZC	128-125, F3 D211	117-109, F8, D119	113-115, R2, D248
GMH	250-244, F6. D168	115-164, R49, D128	173-144, F29, D140
PLD	320-324, R4 D230	187-169, F18, D136	185-132, F53, D213
NM			
TF	320-300, F20, D198	189, L, D150	185-154, CC31,D205
JL	267-285, R18, D229	167-183, R16,D103	175-154, F21, D106

GG	277-275, F2, D244	255-207, F48,D142	195-189, F6, D56

xii. ..**he2+zi0 man3**... `Please repeat `the box is full'.'

TM	**he2**	**zi0**	**man3** T203
LZC	115-134, R19, D219	121-109, F12, D143	109-111, R2, D234
GMH	199-222, R23, D144	214-189, F20, D101	175-158, F17, D76
PLD	201-267, R66, D186	224-183, F41, D128	179-228, CC49,D304
XGC	142-136, F6, D90	144-111, F33, D197	111-107, F4, D111
NM			
TF	222-294, R72, D139	292-312-261,CV31,D79	179-146,CC33,D235
JL	154-246, R92, D149	230-232, R2, D183	142-97, F45, D73
GG	220-263, R43, D191	275-232, F43, D244	203-160, F43, D167

xiia. ...**fa2+zi0 hao3**... `Please repeat `the method is fine'.'

TM	**fa2**	**zi0**	**hao3** T203
LZC	112-111, F1, D179	123-114, F9, D84	114-108, F6, D378
GMH	197-173, CC24,D164	201-199, F2, D76	201-160, F41,D163
PLD	**228-265, R37, D103**	**232-220, F12, D57**	**169-175, CC6,D273**
XGC	156-126, F30, D234	158-128, F30, D182	126-101, F25,D188
NM			
TF1	**224-302, R78, D259**	**302, L, D54**	**195-72, F123,D200**
TF	**228-285, R57, D137**	**183-177, F6, D75**	**189-175, CC6,D273**
JL1	152-138, CC14,D119	246-261, R15, D84	72-80, R8, D108
JL	185-140, CC45,D143	220-250, R30, D120	58-60, R2, D46
GG1	**220-253, CC33,D236**	**214-250, R36, D167**	
GG	**197-244, R47, D215**	**222-240, R18, D160**	**208-210, R2, D109**

Syllable duration measurements of the data suggest that both speaker groups share the range of syllable weights proposed to typify all Chinese languages, e.g. by Duanmu 1990, who argues that all stressed non-final syllables are bimoraic, all final syllables are potentially trimoraic, and completely unstressed `toneless' syllables are monomoraic. Duanmu's typology and his "no contour principle" predict that toneless syllables can support a single tone. Some of the NM evidence, such as T2 also T4 reassociation of the second toneme to the following stressless syllable, supports his view. However, in general a considerably enriched range of possible realizations of pitch on stressless syllables is attested, including contours (some of which are, to be sure, phonetically longer than average.)

Evidence from 40 Chinese languages and dialects presented in Davison 1989 shows that distribution of the two parametric values of phonetic default tone realization + interpolation and/or spreading vs. phonological default tone assignment is areal, not genetic, inasmuch as Chinese languages found north of the Yangtze generally follow the Northern Mandarin pattern, those south of the Yangtze the Taiwanese/Taiwanese Mandarin one. The widely dispersed group of genetically related Mandarin dialects thus is split in two. Borderline Jin Mandarin dialects show both values (Huojia) or spread tones to toneless syllables phonologically (Changzhi), see Davison 1989 & 1990.

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2. Additionally, one systematic exception may be noted. In (9iv) 4/5 TM speakers (as well as 3/3 NM speakers) produced a rising tone across the stressless syllable, the syllable itself being of unusually long duration, in the range of 113-294 milliseconds, with 6/8 tokens over 200 ms in length. The standard analysis of this example is that the word **tai+zi** \`prince' has two fully-toned syllables, T4 + T3, and that in the sequence tai+zi hao \`the prince is fine' the T3 T3 sequence undergoes the Mandarin third tone sandhi rule. Elsewhere the **zi** of **taizi** resembles a stressless syllable, being short of duration and acquiring pitch as for stressless syllables, cf(9vi-viii).

3. Due to space considerations the table does not include values for the difference in Hz between the endpoint of the tone on the first syllable and the beginning point of the point on the second syllable; and the endpoint of the tone on the second syllable and the beginning point of the tone on the third syllable. These numbers, easily calculated, are twice as large for NM as TM speakers, hence the interpretation of NM as H-L-H vs. TM as H-M-H.

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