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Third Tone Prominence*

1. Introduction

The four tones of Mandarin Chinese are involved in various sandhi processes. The most well-known and thoroughly studied of these phenomena is traditionally assumed to turn a third tone into a second tone before another third tone. Despite all the attention third tone sandhi has received in the literature (see e.g. Yip 2000 and Chen 2000), Optimality-Theoretic (OT) accounts of the phenomenon are sparse and not always convincing. In this paper, I follow Yip's (2000) initiative of working out an OT account that is driven in part by de Lacy's (1999, 2002a) tone prominence constraints. These constraints favor higher tones in prominent and lower tones in non-prominent positions.

In the remainder of this introductory section, I will provide some background information about the Mandarin tone system, the third tone sandhi phenomenon, and de Lacy's tone prominence constraints. Then, in section 2, I will lay the groundwork for my analysis. The OT part of the proposal will be fully fleshed out in section 3. The last two sections are devoted to residual issues and the conclusion.

1.1 *Mandarin tones and third tone sandhi*

The four contrastive tones of standard (i.e. Beijing) Mandarin are listed in (1). T1-T4 represent the four tonal categories, the numbers in square brackets indicate pitch levels, and the letters stand for high (H), mid (M), and low (L) tone segments.

(1) Mandarin tone system (Chen 2000)

T1	high level	[55]	H
T2	rising	[35]	MH
T3	dipping	[214]	MLH
T4	falling	[51]	HL

T1 is the only level tone; the other three are contour tones. The three pitch levels of T3 form a complex contour. In connected speech, the citation form of these tones is often altered. Besides various coarticulation effects resulting in pitch level changes that are too slight to be perceptible to the unaided ear, there are a few tone sandhi (TS) processes, dissimilatory or assimilatory, which seem to result in

* This paper is an extension of previous work I did on third tone sandhi in focus positions. The main goal is to build on the crucial parts of the earlier paper, gain a deeper understanding of the phenomenon, present new insights, and solve some of the problems my OT account faced. My thanks to Jenn Smith and Armin Mester for consulting with me and encouraging me to stay with this ongoing project.

categorical tone changes. The most well-known of these processes is T3 sandhi, which, according to Chen and other researchers (e.g. Lin 1993), can be broken down into two parts, as shown in (2).

(2) T3 Sandhi
a. T3 [214] → T2 [35] / __T3 [241]
b. T3 [214] → T3 [21] / elsewhere

(2a) is the prototypical T3 sandhi rule which is traditionally represented as a T3 changing to a T2 before another T3, and (2b) is what Chen calls the "half T3 sandhi." This latter process turns the citation contour [214] into the low truncated form [21] when T3 occurs anywhere but before another T3. Utterance-finally, the final rise of [214] is optionally preserved. Thus, Chen lists the following allotones of T3.

(3) Allotones of T3

		allotones [214]	[21]	[35]
sandhi contexts	before [214]	–	–	+
	utterance-final	+	+	–
	elsewhere	–	+	–

In section 2 of this paper, I will take issue with the [35] representation of the T3 sandhi allotone. I will also add another environment in which the full underlying [214] contour of T3 is realized. Generally, however, I agree with the concept of a T3 allotone system.

1.2 *Tone Prominence*

Yip (1980, 2000), who takes T3 to be underlyingly specified as L only, represents T3 sandhi as a dissimilatory process that inserts an H tone segment (or "toneme") between two Ls. The resulting LH is then perceived as MH, i.e. a T2. This is shown in (4)

(4) T3 → T2 / __ T3
L → MH/ __ L (or: L.L → MH.L)

In order to make her "H-insertion" representation of T3 sandhi compatible with de Lacy's (1999, 2002a) tone prominence constraints, which are given in (5), Yip concludes that T3 sandhi must apply in binary constituents which are left-headed. Insertion of H on the non-head of the constituent would violate de Lacy's *NONHD/H, which bans high tones from foot non-head positions.

(5) Tone prominence hierarchies
*HD/L >> *HD/M >> *HD/H
*NONHD/H >> *NONHD/M >> *NONHD/L

De Lacy's constraints[1], which Yip (2000) classifies as negative positional markedness constraints, combine a tone prominence scale (H > M > L) with a structural prominence scale that has the Designated Terminal Element (DTE) as its relevant unit of structure. The DTE or head of a foot is more prominent than its non-head. The given rankings are universally fixed. In the next two sections, I follow Yip in proposing an account of T3 sandhi that is compatible with de Lacy's tone prominence constraints. My analysis differs from Yip's in terms of the empirical generalizations on which I base my proposal. While both Yip and Chen argue that T3 changes to T2 under contrastive stress, I maintain that the full underlying contour, namely [214] gets preserved.

2. T3 sandhi as toneme deletion

In this section, I present and defend my version of Chen's (2000) T3 allotone system and explain how it leads to a positional faithfulness (Beckman 1997) account. Furthermore, I will compare my proposal with Yip's (2000) and question the nature of the domains in which TS applies.

2.1 *T3 allotones*

Since the low truncated [21] allotone of T3 can nicely be derived from the full underlying contour [214] by deletion of the final toneme, I propose that a T3 preceding another T3 (traditionally represented as [35]) be derived by a deletion process as well. In order to derive a rising tone from [214], all that needs to happen is deletion of the low middle toneme. The result is [24], which presumably does not differ much from [35] perceptually. In fact, even if there is a slight audible difference, the proposal of representing a post-sandhi T3 as [24] instead of [35] finds support in the literature. As reported by Chen (2000),

> Zee (1980) shows that underlyingly T3 preceding another T3 has an overall lower F_0 (fundamental frequency) than the corresponding T2 in the same environment. This would seem to suggest that T3 Sandhi does not entail a paradigmatic substitution of T3 by T2, but rather only turns T3 into some allotone, say T3', in the sandhi context, and hence maintains the categorical distinction between T2 and T3' (pp. 26-27).

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[1] In his 1999 manuscript, de Lacy uses DTE (□) and non-DTE (-□) instead of Head (HD) and non-Head (NONHD). The notation given here is from his 2002 publication and has also been used by Yip (2000). Unlike the 1999 version, however, the 2002 hierarchies do not include the lowest-ranking constraints, *HD/H and *NONHD/L. He explains that the lack of constraints against high-toned heads and low-toned non-heads ensures that these types are the least marked of all.

In his dissertation (2002b), de Lacy formalizes these constraints as stringent and freely rankable: *$\square_{Ft}$□H (*$\square_{Ft}${H,M,L}), *$\square_{Ft}$□M (*$\square_{Ft}${M,L}), *$\square_{Ft}$□L (*$\square_{Ft}${L}) and *-$\square_{Ft}$≥L (*-$\square_{Ft}${L,M,H}), *-$\square_{Ft}$≥M (*-$\square_{Ft}${M,H}), *-$\square_{Ft}$≥H (*-$\square_{Ft}${H}). For the purposes of this paper, the distinction between the stringent and the non-stringent version of the constraints is not crucial. The non-stringent constraints relevant for my analysis in sections 2 and 3 are *HD/L and *NONHD/H. The corresponding stringent constraints are *$\square_{Ft}$□L (*$\square_{Ft}${L}), where M and H do not incur a violation, and *-$\square_{Ft}$≥H (*-$\square_{Ft}${H}), where M and L do not incur a violation.

Another discrepancy between Chen's and my allotone systems is the environment in which the underlying contour of T3 occurs. According to the empirical generalizations resulting from my own work with a native-speaking informant[2], the [214] contour of T3 is preserved under contrastive stress. In fact, even when the informant was asked not to contrastively stress anything, the word that seemed to receive neutral sentence stress also failed to undergo T3 sandhi, i.e. did not change to a T2. Since regular sentence stress in Chinese is, as Chen puts it, "phonetically elusive," I will not distinguish between contrastive and neutral sentence stress. The finding that the full contour of T3 gets preserved under stress contradicts the standard assumption that low tones are the least salient and thus incompatible with prominent positions (de Lacy 1999) and has not been noted in the literature before. While I support the consensus that an underlying T3 in focus position is realized with a high final rise, just like a T2, I disagree on the disappearance of the low T3 dip. My informant prolonged and thereby exaggerated the full T3 contour, including both the dip and the rise. Considering that [214] contains not only an L but also an M and even an H segment, the stressability of T3 apparent in my data is not all that surprising. It could be that a stressed T3 is generally transcribed as [35] because the exaggerated high rise immediately gets associated with a T2. To sum up, the T3 allotone system I propose is given in (6).

(6) T3 [MLH] allotones:
(i) under stress[3]: MLH
(ii) before T3: M[L]H → MH
(iii) elsewhere: ML[H] → ML

As will be shown in section 3, the "under stress" allotone (6i), i.e. the allotone that resists toneme deletion, can be given a classic positional faithfulness account, where MAX-□(T) protects the stressed contour from toneme deletion. As for the other two allotones (6ii-iii), besides the slight pitch-level difference in the representation of MH ([35] vs. [24]), my toneme deletion system makes the same predictions as traditionally assumed. Now, however, both the prototypical T3 sandhi variant in (ii) and the elsewhere (or half T3 sandhi) variant in (iii) are neatly derivable by one simple move. Combining both parts of Chen's T3 sandhi (i.e. including the "half" rule), T3 sandhi as a whole can be formalized as follows.

(7) T3 sandhi
MLH.MLH → MH.ML

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[2] I am referring to a recoded set of data I collected for a previous project. My informant was a native Beijing Mandarin speaking graduate student in the Linguistics Program at Boston University. In order to make sure my transcriptions of the tonal patterns are accurate, I consulted Florence Woo, a native speaker of Cantonese, who is also fluent in Mandarin.

[3] Since I do not want to deal with the optionally preserved H in utterance-final position, I am not listing this environment here. As the end of an utterance often seems to coincide with sentence stress (see Chen 2000), the two environments at least partially overlap.

The first T3 occurs before another T3 and is therefore realized as MH. The second T3 is in an elsewhere environment and consequently surfaces as ML. Comparing the traditionally assumed with the newly proposed T3 sandhi rule in (7), they both serve the purpose of dissimilation and contour reduction. The rule in (7), however, has the advantage of allowing for a more elegant OT account. Since a language in which tone is contrastive probably protects underlying tone categories with a high-ranking IDENT(tone) constraint, a change from T3 [214] to T2 [35] is unlikely. In contrast, a change that deletes a tone segment but preserves the categorical identity of the underlying tone merely requires a low-ranking MAX(tone segment) constraint. As for the deletion of either L or H, section 3 will demonstrate how de Lacy's (1999, 2002a) tone prominence constraints make the right predictions. Yip's (2000) T3 sandhi analysis is based on a toneme *insertion* system that also allows for an efficient OT account. Her proposal is the focus of the following subsection.

2.2 *The H-insertion alternative*

As mentioned in the introduction, Yip (2000) posits L as the underlying representation of T3. Her version of the T3 sandhi rule was given in (4) and is repeated here as (8)

(8) (L.L) → (MH.L)[4]

Referring to Chen's (2000) work, Yip claims that T3 sandhi takes place within prosodic constituents that are preferentially binary and also influenced by syntax. Within these binary constituents, the left syllable must be the head because the creation of a rising tone, i.e. the insertion of an H segment, on the non-head of the constituent would violate de Lacy's *NONHD/H. The constraint ranking Yip needs to account for her T3 sandhi representation is shown in (9).

(9) T3 sandhi as H-insertion
OCP >> DEP-H >> *NONHD/H, MAX/L
*FOCUS/L >> BIN

In order for H-insertion to be allowed, the OCP, which drives the dissimilation, must outrank DEP-H. Since a positional faithfulness account disallows insertion or deletion involving elements in prominent, i.e. head, positions, Yip argues against it, of course. As for contrastively stressed T3s, Yip, like Chen and many other researchers (see e.g. Chang 1992), claims that a change to T2 occurs, even if the TS domain boundaries have to be redrawn in such a way that the binarity requirement (BIN) of the constituents and their alignment with the underlying syntactic structure are violated. This is illustrated in (10). The

[4] Again, technically H-insertion leads to (LH.L), not (MH.L). Yip explains that there is no audible difference between the two rising contours.

utterance in (a) shows canonical T3 sandhi application, whereas the same utterance in (b) contains a contrastively stressed (underlined) element.

(10) a. only buy stocks
zhi mai gu-piao
L L L HM U.R.
(MH L) (L HM) Sandhi
b. zhi mai gu-piao
L L L HM U.R.
(L) (MH L) (HM) Sandhi

In order for H to get inserted on the contrastively stressed syllable, i.e. in order for *mai* to be in head position, the domain boundaries get redrawn. This results in two monosyllabic constituents and the break-up of the compound *gu-piao*. According to Yip, all this is caused by the undominated constraint *FOCUS/L, which she considers a type of *HD/L constraint. Chen at least partly supports this view in that he argues for an inviolable constraint he calls IP-BOUND which says that TS domains cannot cross Intonation Phrase boundaries. Special intonation or focus thus overrides the principles according to which TS domains are built[5]. This issue will be addressed again in subsection 2.3.

My empirical generalizations force me to argue against Yip's H-insertion account. Since I maintain that the full T3 contour surfaces under stress, an underlying L would require both H and M-insertion. Assuming that the underlying form is MLH thus leads to a simpler, more economical solution. Furthermore, my positional faithfulness approach does not need to redraw the TS domains in the case of contrastive stress. If, as Chen claims, there is evidence for the existence of TS domains that is not based on TS application, then it is desirable to avoid (as much as possible) redrawing the domains in order to fit the tonal patterns. The crucial elements my account shares with Yip's are left-headed TS domains and the appeal to de Lacy's tone prominence constraints. Since my representation of T3 sandhi involves the deletion of L on the first T3, i.e. the head, and the deletion of H on the second T3, i.e. the non-head, I need to appeal to both *Hd/L and *NonHd/H. As the tableaux in section 3 will demonstrate, the interaction of the positional faithfulness constraint Max-□(T), the tone prominence constraints, and general Max(T) determines the correct tonal outputs without domain changes. The tonal pattern my account predicts for Yip's data in (10) is given in (11).

(11) a. only buy stocks
zhi mai gu-piao
MLH MLH MLH HM U.R.
(MH ML) (ML HM) Sandhi

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[5] Unlike Yip, however, Chen argues for a high-ranking constraint ("No Straddling," see subsection 2.3) that ensures the unity of immediate syntactic constituents such as compounds.

b. zhi mai gu-piao
MLH MLH MLH HM U.R.
(MH MLH) (ML HM) Sandhi

The first constituent in (11a) shows the canonical T3 sandhi application, following the rule I give in (7). The second constituent contains a T3 followed by a non-T3, here a T4 (realized as HL or HM). This is one of the environments where the elsewhere allotone ML shows up. In (11b), the contrastively stressed syllable is protected by MAX-□(T), while the first syllable behaves just like it would in the canonical T3 sandhi pattern; it loses its L tone segment. The resulting MH contour is in conflict with Yip's transcription of this syllable in (10). Which output is correct is an empirical question, of course[6].

2.3 *Sandhi domains*

One of the biggest and as of yet unsolved mysteries of the T3 sandhi phenomenon is the nature of the domains within which it applies. Although Yip (2000) states that these domains are preferably binary, based on syntax, and left-headed, she does not explain how they come to be left-headed. She does not provide evidence for the association of stress with the heads of these constituents. What does a head represent when there is no stress involved. The answer could be a kind of mark for a rhythmic pattern that aids in the pronunciation of long strings of syllables. Yip also does not address the question of headedness in domains that are bigger than binary. There are many attested utterances consisting of strings of T3s, where all but the last T3 are realized as the rising allotone. Do domains like that have multiple heads? In order for Yip's and my analyses to work, the answer must be yes. De Lacy's (1999, 2002a) tone-prominence constraints require that every T3 which undergoes H insertion and every T3 which undergoes L deletion be a head. Chen (2000), whose account is couched in a derivational version of OT, and for whom the existence of heads is not crucial, does not have this problem. He does, however, have to deal with finding evidence for the existence of TS domains independent of T3 sandhi application. He maintains that Mandarin TS domains, since they can be both sub and supralexical, are neither stress-feet nor phonological phrases. In fact, they do not fit into the conventional prosodic hierarchy at all. Chen thus proposes what he calls the Minimal Rhythmic Unit (MRU) as the relevant domain. He states:

> Clearly, the MRU stands apart from the conventional prosodic hierarchy; it is basically a device to group syllables of a wide variety of grammatical ranks and status into rhythmic units, as determined largely by constituency or tree configuration. The MRU constitutes a prosodic unit sui generis; it is off-scale, hors-séries, so to speak. For this reason, I have settled on MRU as a neutral term vis-à-vis the conventional prosodic hierarchy (pp. 377-378).

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[6] According to my Cantonese-speaking informant Florence Woo, it seems more natural to pronounce a slightly rising than a low falling tone before the fully realized T3 contour. This is an argument for the tonal pattern my analysis, rather than Yip's analysis, predicts. More fieldwork is needed to confirm the validity of this argument.

As for the way MRUs are built, Chen adopts Shih's (1986) Foot Formation Rules (FFR), as listed in (12), and encodes them in the constraints given in (13).

(12) Foot Formation Rules:
a. Immediate Constituency: Link immediate constituents into disyllabic feet.
b. Duple Meter: Scanning from left to right, string together unpaired syllables into binary feet, unless they branch to the opposite direction.
c. Super-foot construction: Join any leftover monosyllable to a neighboring binary foot according to the direction of syntactic branching.

(13) No Straddling, IP-Bound >> Binarity >> Boundedness >> Congruence >> LtoR

No Straddling	Immediate constituents must be MRU-mates.
IP-Bound	MRUs are IP-bound.
Binarity	The MRU is at least disyllabic.
Boundedness	The MRU is at most disyllabic.
Congruence	Group X forms an MRU with its closest morphosyntactic mate.
LtoR	MRUs are constructed from left to right.

As already alluded to in subsection 2.2, IP-Bound, i.e. the influence of intonation and focus, is ranked high enough to override almost all aspects of the FFRs. Another factor that can impact the formation of MRUs is tempo. "In fast or allegro speech, it is possible for TS to apply simultaneously to a right-branching structure (3 [3 3]), as if it were 'flat' or 'unstructured' foot (p. 379). Finally, what makes these TS domains appear even less real is the fact that, besides obligatory intra-MRU, there is also optional inter-MRU TS application. The only MRU-supporting piece of evidence that Chen has to offer independently of T3 sandhi application is Chinese versification. For now, I follow Yip in focusing on binary TS domains only and in assuming that they are left-headed. Unlike Yip, however, I claim that the heads of these domains are not associated with stress. Stress can independently be assigned to any syllable, whether in head or non-head position. If there were a way to make Chen's MRUs compatible with headedness, so that there may be more than one head per TS domain, I would adopt his domain formation constraints and include them in my account in the following section. Since I will not be able to solve the question of headedness in this paper, however, I am forced to take the construction of TS domains for granted and simplify my optimizations by already including the domains in the input.

3. OT Account

Having laid the groundwork for and motivated my account of T3 sandhi as toneme deletion in section 2, I now present the optimization processes that determine the three T3 allotones and thus the desired tonal patterns in my reanalysis of Yip's (2000) data shown in (11). The first subsection presents a positional faithfulness account of canonical T3 sandhi and contour preservation under stress. The second subsection deals with the various elsewhere cases.

3.1 *Canonical T3 sandhi and contour preservation under stress*

As has been established in section 2, the realization of the full underlying T3 contour in stressed positions can be accounted for by a classic positional faithfulness account. The constraint ranking is given in (14). T stands for tone segment or toneme.

(14) Positional faithfulness
MAX-□(T) >> *NONHD/H, *HD/L >> MAX(T)

De Lacy's (1999, 2002a) negative positional markedness constraints are sandwiched between a positional and a general faithfulness constraint. A T3 that is not protected by MAX-□(T), is forced to undergo toneme deletion. If it is in a non-head position, it must lose its H segment. Conversely, if it is in a head position, it must lose its L segment. Violating MAX(T) is least costly, but toneme deletions are suboptimal if they occur after markedness has already been satisfied. These constraint interactions are shown in tableaux (15) and (16).

(15) Preservation under stress: (MLH.MLH) → (MH.MLH)

/(MLH.MLH)/	MAX-□(T)	*NONHD/H,	*HD/L	MAX(T)
a. (MLH.MLH)		*	*!	
☞ b. (MH.MLH)		*		*
c. (MH.ML)	*!			**

(16) Canonical T3 sandhi: (MLH.MLH) → (MH.ML)

/(MLH.MLH)/	MAX-□(T)	*NONHD/H,	*HD/L	MAX(T)
a. (MLH.MLH)		*!	*	
b. (MH.MLH)		*!		*
c. (MLH.ML)			*!	*
☞ d. (MH.ML)				**
e. (MH.M)				***!

Although my representation of T3 sandhi results dissimilation and contour reduction, there is no need to appeal to the OCP or *COMPLEXCONTOUR yet. Both are subsumed by the tone prominence constraints. This, of course, has to do with the sequence of tonemes in adjacent T3s. As shown in the next subsection, when one of the tones in the domain is not a T3, it becomes necessary to invoke not only additional markedness but also faithfulness constraints. Each of these constraints, however, seems generally plausible in that it can be motivated independently of T3 sandhi.

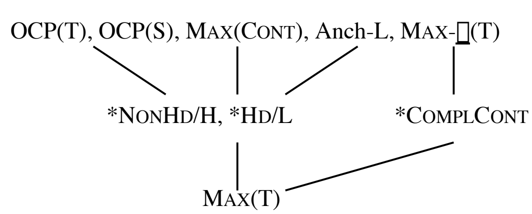
3.2 *Elsewhere cases*

This subsection presents the optimization of the various elsewhere cases or, as Chen (2000) calls them, “half T3 sandhi” applications. One of these cases is represented in Yip’s (2000) data, my reanalysis of which is given in (11). The second TS domain includes a T3 followed by a T4. Yip represents this T4 as HM instead of HL, i.e. its citation form. According to Chen, the slightly reduced fall in HM is the result of a barely perceivable coarticulation effect. As for the optimization shown below, the M-L toneme substitution does not make a difference. Besides the OCP (sensitive to both overall tones (T) and tone segments (S)) and *COMPLEXCONTOUR, the faithfulness constraints MAX(CONTOUR) and ANCHOR-L(CONTOUR) must be added to the current ranking. Definitions of the new constraints are listed in (17).

(17)	OCP(TONE)	No adjacent identical tones (except H.H)
	OCP(SEGMENT)	No adjacent partially identical tones (*L.LH, *H.HL, etc.)
	*COMPLEXCONTOUR	No contour tones with more than two segments (*MLH)
	MAX(CONTOUR)	No change from contour to level tone
	ANCHOR-L(CONTOUR)	No deletion of leftmost tone segment

Both the OCP constraints are adopted from Chen, who shows them in action to account for the northern Mandarin dialect Tianjin. *COMPLCONT is crucial in forcing T3 to reduce even if the desired toneme deletion does not satisfy and is therefore not driven by the tone prominence constraints *NONHD/H and *HD/L. Since a T3 occurring before a non-T3 in the same domain is in head position but must be realized as the truncated ML elsewhere allotone, *HD/L cannot be satisfied and is too low- ranking to make a difference. The role of *COMPLCONT is to force T3 reduction and thereby making it susceptible to at least one of the constraints that outrank *NONHD/H and *HD/L. MAX(CONT) is the most important constraint for the optimization of elsewhere cases because, ranked above the tone prominence constraints, it ensures that *NONHD/H and *HD/L can only reduce the contour of tones that still have contour after toneme deletion. Therefore, only the contour of T3 is allowed to undergo toneme deletion. T1, T2, and T4 are not affected. ANCHOR-L(CONT) must also outrank the tone prominence constraints because the latter cannot be satisfied by deletion of the leftmost tone segment. Finally, all the markedness constraints must outrank MAX(T) because, in general, toneme deletion is a way to satisfy dissimilation, contour complexity, and tone prominence. The crucial rankings are summarized in (18).

(18) Overall ranking:



The following tableaux show the three possible T3 elsewhere cases in the environment of a following non-T3. The obvious pattern in all three tableaux is that the elsewhere ML realization of T3 wins despite the occurrence of L in head position because the alternatives toneme combinations all fatally violate at least one of the higher-ranking constraints. The same holds for the various elsewhere cases in the environment of a preceding non-T3.

(19) Elsewhere case, T3 before T4: (MLH.HL) → (ML.HL)

/(MLH.HL)/	OCP (T)	OCP (S)	*COMPL CONT	MAX (CONT)	ANCH LEFT	*NONHD /H	*HD/L	MAX (T)
a. (MLH.HL)		*!	*			*	*	
b. (MH.HL)		*!				*		*
☞ c. (ML.HL)						*	*	*
d. (ML.L)				*!	*			**

(20) Elsewhere case, T3 before T1: (MLH.H) → (ML.H)

/(MLH.H)/	OCP (T)	OCP (S)	*COMPL CONT	MAX (CONT)	ANCH LEFT	*NONHD /H	*HD/L	MAX (T)
a. (MLH.H)		*!	*			*	*	
b. (MH.H)		*!				*		*
☞ c. (ML.H)						*	*	*
d. (M.H)				*!		*		**

(21) Elsewhere case, T2 before T2: (MLH.MH) → (ML.MH)

/(MLH.MH)/	OCP (T)	OCP (S)	*COMPL CONT	MAX (CONT)	ANCH LEFT	*NONHD /H	*HD/L	MAX (T)
a. (MLH.MH)			*!			*	*	
☞ b. (ML.MH)						*	*	*
c. (LH.MH)					*!	*	*	*
d. (MH.MH)	*!					*		**
e. (MH.M)				*!				**

4. Residual Issues

The biggest issue that remains unresolved is the nature of the domains in which TS applies. It is impossible to give an account driven by de Lacy's (1999, 2002a) tone prominence constraints if TS domains do not allow for the possibility of multiple head positions. As briefly discussed in section 2.3, both Yip's (2000) account and the analysis I present here can only predict the rising MH allotone in the desired positions if there is but one non-head per TS domain. This is a problem for T3 sandhi applications that extend over a longer stretch of syllables, i.e. for TS domains that are bigger than binary. The example in (22) is taken from my own data collection.

(22) Old Li buy <u>good</u> wine
Lao Li mai <u>hao</u> jiu
MLH MLH MLH <u>MLH</u> MLH U.R.
(MH MH ML) (<u>MLH</u> ML) Sandhi

In a derivational account with cyclic rule application, the T3 sandhi process in the ternary constituent in (22) can be represented as follows. To simplify the diagram, I use 3 to represent the non-rising T3 allotones and 2 to represent the rising allotone, i.e. the result of the prototypical T3 sandhi rule.

(23) Cyclic application of T3 sandhi
(3 3) 3
(2 (3) 3)
(2 (2) 3)

The underlined parts of the structure represent the current window of binary T3 sandhi application. After the first 3 has changed to a 2, the window, and thus the TS domain, moves on to the second and third 3. The result is two sandhi tones followed by one remaining 3. The middle position of the string is the non0head of the first round of sandhi application, but it is the head of the second round. In order for *NonHd/H to make the right prediction in parallelist OT, this middle position must count as a head. It may be possible to get rid of the overlapping domain boundaries by appealing to Truckenbrodt's NONRECURSIVITY, which says that domains that are not disjoint in extension are identical in extension, but the headedness problem remains.

Another point worth discussing is how the proposed T3 sandhi account fares with respect to the other sandhi processes of Beijing Mandarin. The only other TS process that Chen reports on is T2 sandhi, which turns a T2 [MH] into a T1 [H] when it is preceded by either a T1 [H] or T2 [MH] and followed by any other tone, i.e. is not utterance-final or at the right edge of its TS domain. The rule is illustrated in (24). The underlined tonemes undergo the change.

(24) T2 sandhi: T2 → T1 / T{1,2} __ T
a. (H.MH.T) → (H.H.T)
b. (MH.MH.T) → (MH.H.T)

There are several things to note. First, this TS rule seems to require a ternary domain. As explained by Chen, T2 sandhi does not apply if T2 is in domain final position. Since my analysis cannot yet deal with bigger-than-binary domains, T2 sandhi falls outside the scope of this paper. More importantly, however, it should be noted that this sandhi process is not dissimilatory but assimilatory in nature. It is thus not driven by the OCP. Since it violates OCP(SEGMENT) as well as the other high-ranking constraints MAX(CONTOUR) and ANCHOR-L(CONTOUR), the analysis proposed in this paper would not be able to account for this process even if it could handle bigger-than-binary domains. I would like to question, however, whether this assimilatory process should have to be accounted for by the constraint interaction established thus far. If it is true that T2 sandhi only occurs in fast speech, as argued by Lin (1993), it may be due to an overriding contour-leveling constraint that flattens out the contour of the middle part of multisyllabic strings. Chen reports on a similar phenomenon in the Wu dialect New Chongming. “The sweeping effect of Leveling is particularly evident in casual speech at faster tempo, as diagnosed by tonal reduction. In these cases virtually all surviving tones emerge simply as H” (p. 282). If, as discussed in section 2.3, tempo has an overriding effect on T3 sandhi, it may also be the constraint responsible for the assimilatory T2 sandhi phenomenon.

5. Conclusion

Although many parts of the big picture regarding the Chinese tone sandhi phenomena are still missing, the analysis of T3 sandhi this paper proposes seems to be a step in the right direction. The research presented here supports the trend started by Yip (2000), which is to make the well-known Mandarin Chinese T3 sandhi phenomenon accessible to non-derivational OT and the prosodic hierarchy. If TS domains are ever going to find a place in the prosodic hierarchy, they certainly need heads. The extended goal of this project is to solidify the empirical generalizations and find a way to account for TS domains that are bigger than binary.

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