

On recent claims about stress and tone in Beijing Mandarin *

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D'après Duanmu (2000), l'accentuation du chinois standard est caractérisée par des pieds accentuels à tête initiale. Parmi les arguments que l'auteur présente en faveur de cette thèse, certains relèvent de la phonologie, et d'autres de la morpho-syntaxe. Nous passons en revue les arguments phonologiques et nous concluons qu'aucun n'emporte la conviction.

Mots clé : Mandarin, accentuation, sandhi tonal, domaine cyclique.

According to Duanmu (2000), stress in Standard Chinese is characterized by left-headed feet. This review examines the phonological arguments given in the book supporting this claim. The conclusion is that the book fails to present any solid phonological evidence in favor of left-headed stress feet in Standard Chinese.

Key words : Mandarin, stress, tone sandhi, cyclic domain.

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1. INTRODUCTION

The syntax-phonology interface has been an area of intense theoretical interest for several decades, and Chinese has come to occupy a prominent place in that line of research, owing to important work on tone sandhi in the Xiamen and Shanghai dialects.¹ As for the Beijing dialect, it is still debatable what it can teach us about the interaction between syntax and phonology. About one-third of the space is devoted to this issue in San Duanmus's *Phonology of standard Chinese* (henceforth PSC). Like the other volumes in the series *The phonology of the world's languages*, the book is a survey of the phonological system of one language within a modern theoretical perspective. PSC covers all the classic questions in the synchronic phonology of Standard Chinese, and in many cases it presents the author's own answers to them. The theoretical framework is that of generative grammar.

The book is intended primarily for linguists with a strong theoretical bent who want to acquire an overall view of the sound structure of Standard Chinese, or learn what new insights current linguistic theorizing has to offer about it. Since it brings together a mass of material not easily accessible to linguists without any knowledge of Chinese, one may expect that it will be widely read and that its claims about stress and tone in Standard Chinese will find their way into the theoretical literature. These claims need a careful review.

The author has gone to great lengths to ensure that his book will also be accessible to readers not familiar with the theoretical developments which have taken place during the last quarter of a century, and this comes at a price for the other readers. He has kept at a minimum technical discussions about the workings of his analyses, but despite the apparent simplicity of his style of exposition, the book is difficult to read. The reader has to work hard

¹ For a survey of the theoretical implications of work on Chinese phonology, see Yip (2003).

at unravelling the crucial assumptions which remain implicit under the apparently undemanding prose.

In this paper I examine PSC's account of stress in Beijing Mandarin (henceforth BM²). According to PSC, the stress system of BM is based on left-headed feet which are derived from morpho-syntactic structure pursuant to the Nonhead stress rule. The author claims that foot structure is central to our understanding of (i) various phenomena in the phonology of BM, and (ii) certain restrictions on word length and on word order in compounds. I will only discuss the phonological side of the author's argument for left-headed feet, i.e. his claims concerning (i). My conclusion will be that PSC does not present any solid phonological evidence for left-headed feet.

The best way to criticize a theory is to present an alternative theory and show that it is preferable. Though I do not have an alternative account of stress and tone sandhi in BM, my hope is that by clarifying various aspects of the account in PSC, this review can be of help in devising an alternative to it.

This paper is organized as follows. Sections 2, 3 and 4 constitute the main course, so to speak; § 2 reviews PSC's account of stress, § 3 discusses the role it plays in PSC's analysis of tone sandhi, and § 4 deals with zero syllables. § 5 is devoted to neutral-toned syllables and weakly-stressed syllables. § 6 and § 7 examine the author's arguments based on other dialects and on versification, and § 8 summarizes the main points of this review.

2. FOOT FORMATION

I first present an outline of SD's account of stress. Readers of PSC must be warned from the outset that when the author of the

² I use BM (Beijing Mandarin) instead of SC (Standard Chinese) to avoid confusion between 'SC' and the initials 'SD' used to refer to the author of the book. The expression 'Beijing Mandarin' is also a reminder of the fact that Standard Chinese is based on the pronunciation of the dialect spoken in the city of Beijing and its vicinity. Only a tiny proportion of the fluent speakers of Standard Chinese are native speakers of that dialect.

book ascribes a certain stress pattern to a BM expression, he does not intend that stress pattern as a factual statement whose empirical adequacy can be checked directly in the usual manner, e.g. through native speakers' judgements of relative prominence, or through phonetic measurements. According to SD, since in general the main phonetic cue for stress is pitch, and since in tone languages pitch is already taken up by the phonetic implementation of tone, the empirical consequences of stress in BM are mostly of an indirect nature. They are to be found in the way stress interacts with tone sandhi and in the role of syllable count in certain areas of morphosyntax. I do not see anything objectionable in principle with this approach. The source of my dissatisfaction lies elsewhere: when the wheels and cogs of PSC's account are laid bare, there emerge loose ends and inconsistencies which destroy whatever conceptual appeal it may have at first blush.

A remarkable feature of PSC's account of stress in BM is that the distinction between words and phrases does not play any role in it. All that matters is the difference between those expressions which have a 'flat' structure and all the others. The latter are all treated in a uniform manner by the stress rules, whether they be disyllabic words or entire sentences.³ In what follows, I use the term 'expression' to refer to any grammatical constituent, from a one syllable morpheme to a complete sentence, and I use 'morpho-syntactic structure' and 'constituent structure' as synonyms covering all levels of constituent structure, below the word level as well as above it.

Following widely-accepted assumptions,⁴ the syllables in an expression are grouped into feet. In a foot there is one syllable, the head, which has more stress than the others. According to PSC, in BM, feet meet the following condition:

³ There is one exception. Foot Shelter ((74) p. 123) is the one component in the apparatus for building feet which makes reference to the distinction between words and phrases. Foot Shelter is not involved in any one of SD's phonological arguments for left-headed feet.

⁴ See e.g. Vergnaud and Halle (1987).

- (1a) a foot must contain at least two syllables;
 (1b) the head of a foot is its first syllable.

In a sequence of feet, some have more stress than others. Here is for instance the representation for *jie2-ke4-si1-luo4-fa2-ke4* 'Czechoslovakia' (feet are henceforth enclosed in parentheses):⁵

- (2)
- | | | | | | | |
|-----|-----|-----|-----|-----|-----|--|
| x | | | | | | |
| x | | x | | x | | |
| (x | x) | (x | x) | (x | x) | |
| jie | ke | si | luo | fa | ke | |

In (2) the first syllable in each foot has more stress than the second, and the first foot has more stress than the others, which is manifested by the fact that its head (*jie*) has more stress than those of the other feet (*si*, *fa*).

According to PSC, the foot structure of an expression is entirely predictable from the phonological material in that expression and its constituent structure. Here is how foot structure is assigned to expressions with a 'flat' constituent structure, such as monomorphemic polysyllables (*pu2-tao0* 'grape') or digit sequences in phone numbers:

- (3) In an expression with a flat constituent structure,
- a build dissyllabic feet, starting from the beginning of the expression;
 - b the initial foot has more stress than the others.

⁵ The transcription is given in *pinyin* with the tone diacritics replaced by numbers ('0' is the neutral tone). These numbers are at times omitted for convenience's sake.

The assignment of foot structure given in (3) is illustrated by (2). Outside of the special cases to which (3) is applicable, feet are built in a cyclic fashion, subject to the Nonhead Stress condition:

- (4) Nonhead Stress: 'between a syntactic head and a syntactic nonhead, the nonhead has more stress' (p. 130).

Consider the expression *zha2 yu2*, which can be either a Verb Phrase ('fry fish') or a compound noun ('fried fish'). According to Nonhead Stress, in the Verb Phrase *yu2* 'fish' must have more stress than *zha2* 'fry', because *zha2* is the head, whereas in the compound it is *zha2* which must have more stress, because *yu2* is the head. Another requirement on foot structure is that it be congruent with constituent structure, at least in the following limited sense:⁶

- (5) No Straddling: If two syllables are sister constituents in morpho-syntactic structure, they belong to the same foot.

Let us see how conditions (1), (3), (4) and (5) interact. Consider first the expression *hao3 jiu3* 'good wine'.⁷ The two syllables must be grouped into a foot in order to satisfy (5), and the Nonhead Stress condition (4) can be met, since all feet are left-headed (v. (1b)), and *hao* is a nonhead. The resulting structure is depicted in (6a) (square brackets indicate morpho-syntactic structure; a double strikethrough on the left or right bracket of a constituent indicates whether that constituent is left- or right-headed):

⁶ (5) is not an independent device posited by SD; it is merely an aspect of his cyclic procedure of foot construction which I have singled out for expository purposes. It is named after a similar requirement proposed in Chen (2000: 369).

⁷ V. (39) p. 249.

On the inner cycle *ya* and *dan* are footed together, which is unproblematic since *dan* is the syntactic head in *ya dan*, and so the head of the foot can be on the first syllable (v. (8a)). On the outer cycle, *xiao* must have more stress than *ya dan*, which is the syntactic head (v. (8b)), but 'to have more stress' is the same thing as to be the head of a foot, and *xiao* cannot be a foot all by itself, for feet must be polysyllabic (v. (1a)). The way out, according to the author, is Foot Merger, which incorporates *xiao* into the following foot, thereby making it the head of the foot, in accordance with (1b). The output of Foot Merger is displayed in (8c).

The derivation in (8) and the accompanying explanations closely follow SD's account.⁹ Note the following problem with Foot Merger and derivations like (8): It is true that (8b) contains 'a monosyllable with main stress', as required by Foot Merger (7), but the stressed monosyllable in (8b) could not have arisen in the first place, for PSC's system does not contain any device that could create it: a syllable can have 'main stress' only if it is the head of a foot, and the feet built by cyclic foot formation must all contain at least two syllables.¹⁰ This conceptual hurdle is a serious one, for PSC's whole account of stress and tone sandhi is couched in terms of sequential derivations. In the discussion below I assume that the problem can be remedied somehow.

3. TONE 3 SANDHI

The principal item of phonological evidence which SD adduces in favor of his account of stress is Tone 3 Sandhi, to which he devotes a whole chapter. Left-headed feet play a central role in PSC's analysis of Tone 3 Sandhi, which the author claims is a better one than those proposed in previous works, notably Shih (1997) and an earlier draft of Chen (2000). SD does not compare his analysis

⁹ V. (28)-(29) p. 138, (41) p. 249, (42) p. 250.

¹⁰ A similar problem is raised by the derivation of (49) p. 251. The first sentence on top of p. 252 implies that *ma* 'horse' is made the head of a monosyllabic foot.

with theirs for empirical coverage; his arguments are mainly of a conceptual nature (v. section 11.5, pp. 253-254). In what follows I point out various problems, both empirical and conceptual, with SD's analysis. These problems make it doubtful that SD's analysis of Tone 3 Sandhi has any advantage over previous ones.

3.1. The Tone 3 Sandhi rules

BM has four lexical tones, viz T1, T2, T3 and T4. T3 Sandhi (henceforth T3S) is a process whereby T3 becomes T2 when it immediately precedes another T3 and both belong to the same Intonational Phrase. While T3S is blocked when the two tones belong to different Intonational Phrases, it is always an option when they are inside the same Intonational Phrase; in that case it is obligatory in some environments and optional in others.¹¹ The main analytical challenge presented by T3S is to devise an account which correctly sets apart (i) those environments in which T3S is prohibited from those in which it is allowed, and (ii), among the latter environments, those in which T3S is mandatory from those in which it is only optional. SD does not mention the issue of intonational phrasing, about which little is known in BM.¹² He concentrates on (ii), i.e. although he does not say so explicitly, he only considers cases in which the adjacent T3 tones belong to the same Intonational Phrase. At first blush the basic idea underlying his account looks the same as in Shih (1997) and Chen (2000). According to these authors, the syllables in an expression are grouped into sandhi domains; T3S must apply if two adjacent T3 tones belong to the same sandhi domain, while it need not apply if they belong to different domains. We illustrate with the example below, in which all syllables have T3 in their lexical

¹¹ In those environments in which it is optional, T3S is facilitated by a faster speech rate, a more casual speech style and the speaker's greater familiarity with the linguistic material.

¹² On intonational phrasing in BM, see Shih (1997: 100-105).

representations.¹³ According to Shih (1997: 86), there are only two licit realizations of the tones, which are shown underneath (9b):

| | | | |
|------|--------------------------|------|-----------------------|
| (9a) | [wo3[mai3[hao3 jiu3]]] | (9b) | <wo3 mai3><hao3 jiu3> |
| | I buy good wine | | 2 3 2 3 |
| | | | 2 2 2 3 |

As shown in (9b), where the sandhi domains are enclosed in angled brackets, the syllables of sentence (9a) form two sandhi domains. T3S is obligatory inside the domains, and consequently *wo3* and *hao3* must surface with tone T2. On the other hand, since the sequence *mai3 hao3* straddles two domains, the application of T3S to *mai3* is only optional. Whereas in Shih and Chen's accounts of T3S the tone sandhi domains are phonological groupings of uncertain theoretical status, SD's account is an attempt to integrate the descriptions of stress and tone sandhi into one coherent system: in that account, all stress feet are sandhi domains. The converse is not true, however. Not every sandhi domain is coextensive with a stress foot, and this asymmetry considerably reduces the appeal of the system presented in PSC, as will be seen in later sections.

In PSC's system there are two cyclic sandhi rules, one obligatory (10) and the other optional (11) and a condition on rule (10) which downgrades it from obligatory to optional in certain environments:

- (10) T3 obligatorily becomes T2 before T3.
- (11) T3 optionally becomes T2 'before T2 that came from T3'.¹⁴
- (12) 'T3S is cyclic **starting from each foot**'.¹⁵

¹³ 'I buy good wine'.

¹⁴ V. (14b) p. 241.

¹⁵ This is (37a) p. 248 with boldface added.

- (13) Cyclic Branch Blocking:¹⁶ Rule (10) is optional when the two syllables meeting its conditions belong to independent 'cyclic branches' (i.e. non-overlapping cyclic domains).

(13) states that rule (10) is optional when the target T3 and the environment T3 belong to different 'cyclic branches', i.e. to non-overlapping cyclic domains. For instance, according to (13), T3S is optional in *[[xiu1-gai3]][(gao3-jian4)]* 'revise a manuscript',¹⁷ because in the sequence *gai3 gao3* either syllable is contained in a cyclic domain which does not contain the other. Contrast this with *[[[(zhan3-lan3)]guan3]li3]* 'inside the exhibition hall'.¹⁸ The last two syllables remain unfooted, and outside the initial foot the cyclic application of T3S (10) is guided by the morpho-syntactic bracketting. T3S is obligatory in the sequence *lan3 guan3* because that sequence is not in the purview of (13), as *lan3* and *guan3* do not belong to non-overlapping cyclic domains: the cyclic domains which contain *guan3* are *zhan3-lan3 guan3* and *zhan3-lan3 guan3 li3*, and *lan3* is included in either sequence.

3.2. The minimal cyclic domains for T3 sandhi are not feet

Before discussing Cyclic Branch Blocking (13), let us examine how the cyclic application of T3S (i.e. of (10) and (11)) is guided by foot structure, which is itself built in a cyclic fashion. The interaction between T3S and foot formation raises a problem which does not appear immediately, due to SD's style of exposition. To remedy this problem, we shall have to abandon PSC's claim that in the cyclic application of T3S the smallest cyclic domains are feet,

¹⁶ A name coined by the present writer. As formulated in (13), Cyclic Branch Blocking only affects the operation of rule (10). SD may have intended the purview of (13) to include also rule (11). This is immaterial for the present discussion.

¹⁷ V. (44) p. 250.

¹⁸ V. (43) p. 250.

with the consequence that the role of feet in tone sandhi is not as important as it may seem at first.

Although SD does not discuss the question explicitly, how he conceives of the interaction between T3S and foot formation is apparent from the layout of the derivations in his examples: When an expression is subjected to the rules, feet are first built cyclically over the whole expression; only after the last footing cycle has been completed does T3S begin its cyclic operation. Call this modus operandi Feet All Over First (henceforth FAOF). I first show that Feet All Over First, which is a crucial component in SD's account, is not consistent with SD's sandhi rules, and I propose a modification of (12) which can in part remedy this inconsistency.

Consider for instance the derivation of [*xiao3*[*zhi3*[*lao3-hu3*]]] 'small paper tiger' ([small[paper[tiger]]]). Derivation (42) p. 250 and the accompanying text describe the following succession of steps (here each syllable is represented by its tone):

- (14) a b c d e
- [3[3[33]]] [3[3(33)]] [3(333)] (3333) (VV23)

Starting from the input (a), feet are first constructed in a cyclic fashion, first on *lao3-hu3* (b), then on *zhi3 lao3-hu3* (c), and finally on the whole expression, yielding a four-syllable foot (d). T3S then applies, hence (e), in which V is SD's shorthand to indicate free variation between T3 and T2 when it is due to the application of the optional T3S rule (11). Let us look more closely at the last step in (14), in which the first three syllables undergo T3S. It is clear from SD's discussion that this last step conflates three successive applications of T3S:

- (15) a b c d
- (3333) (3323) (3V23) (VV23)

The obligatory T3S rule (10) first applies to the final 33 sequence in (a), yielding (b); optional T3S (11) then applies to the sequence 32 in (b), hence (c); optional T3S applies again, this time to the sequence 3V in (c), hence (d). Now, by hypothesis the four syllables in the input (15a) form a single foot. Since by (12) the smallest cyclic domain is the foot, and since SD's system does not make any provision for right-to-left application of T3S inside a cyclic domain, one is forced to conclude that what determines the order of the successive applications of T3S in (14) is cyclic application. One must assume, then, that foot formation is immediately followed by T3S on each cycle, i.e. when foot formation operates on a given cycle its input has already undergone T3S on earlier cycles.

(16) is a restatement of derivation (14) under the assumption that T3S immediately applies after foot formation on each cycle. Each cycle is represented on a separate line, with its successive steps ordered from left to right. As in (14a), the input to the derivation is [3[3[33]]].

| (16) | input | foot form. | T3S |
|---------|--------------|---------------|---------------|
| Cycle 1 | [33‡ | [(33)] | [(23)] |
| Cycle 2 | [3[(23)]‡ | [(3[23])] | [(V[23])] |
| Cycle 3 | [3[(V23)]‡ | [(3[V23])] | [(V[V23])] |

(16) represents the standard view about the interaction of ordered rules under cyclic application,¹⁹ and FAOF is a theoretical innovation which remains underground in PSC. Although derivation (14) seems to require cycles proceeding in the standard fashion illustrated in (16), we will see in the next section that some derivations crucial for PSC's claims about stress in BM rely crucially on Feet All Over First. The FAOF mode of application must be retained, then, and

¹⁹ See Chomsky and Halle (1968).

some other component in PSC's system must be modified in order to make derivation (14) compatible with FAOF. To achieve this result, let us abandon SD's stipulation that feet are the smallest cyclic domains as far as rules (10) and (11) are concerned. Let us delete the phrase in boldface from condition (12); from now on we assume that (12) simply reads as 'T3S is cyclic'. With this modification, step (14e) conflates the sequence of steps (15), in which the cyclic application of T3S is driven by morpho-syntactic structure.

3.3. Feet are just cyclic branches of a special kind

In this section I show that FAOF is crucially involved in PSC's analysis of T3S. Then I argue that the objects which play a central role in PSC's analysis of T3S are cyclic branches rather than feet.

In the section of PSC where the analysis of T3S is presented (p. 248-253), most of the space is devoted to derivations showing how that analysis accounts for fourteen examples already introduced in the previous sections in the same chapter. In nine out of the fourteen derivations, the output would remain the same if there were no foot structure and the cyclic operation of SD's tone sandhi rules only looked at morpho-syntactic structure. Let us examine the remaining five derivations, in which foot structure impinges on tone sandhi, those numbered (46), (48), (49), (51) and (52) in Chapter 11.

Let us leave aside derivation (52), which purports to show how PSC's system accounts for the influence of focus on T3S. The author's discussion of this example is not detailed enough to enable readers to work out how his account would extend to other cases involving different constituent structures, and consequently example (52) can hardly be considered strong evidence in favor of PSC's analysis of stress in BM.²⁰ Let us turn to the remaining four examples to see how foot structure and tone sandhi interact.

²⁰ Lin (2001: 461) points out that while on pp. 252-253 it is assumed that 2334 is a licit tone sequence for example (52), this is denied on pp. 239-240.

Consider, for instance, derivation (48) p. 251, which assigns the surface tone sequence 2331 to the sentence *wo3 xiang3 mai3 shu1* 'I want to buy books'. Let us first show how PSC's rules would operate if cyclic application operated in the standard way.²¹

| | | |
|--------------|----------------------------|--|
| (17) | input | [wo3 Ꞥ xiang3 Ꞥ mai3 shu1]]Ꞥ I want buy book |
| Cycle 1 | input foot form. T3S | Ꞥmai3 shu1] [mai3 (shu1 Ø)] ²² — |
| Cycle 2 | input foot form. T3S | Ꞥxiang3 [mai3 (shu1 Ø)]] — 2 |
| Cycle 3 | input foot form. T3S | [wo3 [xiang2 [mai3 (shu1 Ø)]]]Ꞥ [(wo3 [xiang2) [mai3 (shu1 Ø)]]] V |
| output tones | | V 2 3 1 |

Derivation (17) incorrectly predicts that *xiang3* obligatorily surfaces with tone T2, due to the obligatory application of the T3S rule (10) during the second cycle. With Feet All Over First, on the other hand, the T3 in *xiang3* is allowed to surface, in conformity with the data. This is shown in (18):

²¹ The dashes indicate derivational steps in which the operation of a rule leaves the representation unchanged.

²² V. (6b) above.

| | | |
|--------------|---------|--|
| (18) | input | [wo3 ɸxiang3 ɸmai3 shu1]] † |
| foot f. | Cycle 1 | [mai3 (shu1 Ø)] |
| | Cycle 2 | [xiang3 [mai3 (shu1 Ø)]] |
| | Cycle 3 | [(wo3 [xiang3] # [mai3 (shu1 Ø)])]] |
| T3S | | 2 |
| output tones | | 2 3 3 1 |

As far as cyclic foot formation is concerned, the successive steps in (18) are the same as those in (17). To save space, all the cycles for T3S have been conflated into one line. In the final foot structure, '#' has been added to signal a boundary between two independent cyclic branches: *xiang3* and *mai3* each belong to a cyclic domain which does not contain the other. The cyclic domains in question are (*wo3 xiang3*), a foot, and [*mai3 shu1*], a phrase. According to Cyclic Branch Blocking (13), rule (10), which would otherwise obligatorily apply to *xiang3*, is only optional, and I follow SD's practice of not representing in the output of derivations the results of optional applications of rule (10).

Although foot structure is the same in the final step of derivations (17) and (18), its influence on T3S is different. In derivation (17), the obligatory application of rule (10) to *xiang3* is not inhibited by Cyclic Branch Blocking (13), because rule (10) applies to *xiang3* during Cycle 2, at a time when *xiang3* and *mai3* do not meet the conditions of Cyclic Branch Blocking, as it is only on Cycle 3 that *xiang3* and *wo3* come to form a foot.

Like derivation (48) p. 251, which we have just discussed, derivations (46), (49) and (51) of pp. 251-252, in which foot structure impinges in a crucial manner on the operation of T3S, all require the FAOF modus operandi. Lack of space prevents us from going through these derivations in detail. Their outcomes are given

below in (19) for either mode of operation of the cyclic rules ((48) is repeated for convenience's sake):

| (19) | | input | FAOF | Standard |
|------|------|-------------------------|----------------------------------|---------------|
| a | (46) | [[<u>33</u> 3 3]] | (<u>23</u>)#(23) | <u>22</u> 23 |
| b | (48) | [3 <u>3</u> 31]] | (<u>23</u>)#[31] | V <u>2</u> 31 |
| c | (49) | [3 [<u>33</u>] 3]] | (<u>23</u>)#(23) | V <u>22</u> 3 |
| d | (51) | <u>3</u> 3 [34]] | (<u>23</u>)#(34) ²³ | V <u>2</u> 34 |

In (19) the center of interest is the tone of the second syllable in each expression, which is underlined for conspicuity. In all four derivations, the application of rule (10) to the second syllable is only optional, because the second syllable and the third belong to independent cyclic branches. As one can see in the FAOF column, the cyclic branch on the left-hand side is always a foot, while that on the right-hand side is a phrase in one derivation (48), and a foot in the other three.

Let us recapitulate what we have shown about those cases in which SD's account of T3S crucially relies on foot structure. First, FAOF is not merely a device for simplifying the exposition; it is an essential component in SD's system. Second, foot formation is crucial in that it contributes to the creation of adjacent non-overlapping cyclic domains which inhibit the obligatory application

²³ In his discussion of this example, SD writes that the first foot is formed by left-to-right foot formation over sequences of unfooted syllables. But if left-to-right foot formation were to apply to *guan3 li3* in *[[zhan3 lan3]guan3/li3]* 'inside of exhibition hall' ((43) p. 250), the predicted tone sequence would be 2323, while the correct outcome is 2223 (v. also (5) p. 238). Let us assume that this can be remedied somehow.

does not play any role in PSC's account of tone sandhi. This leads to serious empirical problems, as the following example illustrates. In (21a), a compound noun meaning 'bucket factory', the head noun *chang3* 'factory' is modified by a Verb-Object construction: 'make-bucket'; in (21b) this compound is part of a locative whose head is *wai4* 'outside'. (21) displays relevant aspects of the derivations of these compounds within PSC's system, when they occur in final position:²⁵

| | | |
|----------|-----------------------------------|--------------------------------------|
| (21) | a | b |
| | make pail factory | make pail factory out |
| | [$\{zao4\ tong3\}chang3\}$] | [[$\{zao4\ tong3\}chang3\}wai4\}$] |
| foot f. | (zao4 tong3)(chang3 \emptyset) | (zao4 tong3) chang3 wai4 |
| T3S (10) | optional by (13) | obligatory |

Before considering these derivations, let us say what the facts are. In the trisyllabic compound *zao4 tong3 chang3*, according to the native speakers' judgement, *tong3* must be pronounced with tone T2, regardless of whether that compound is uttered in isolation (21a), or embedded in a larger expression (21b). This is an instance of what Chen (2000: 382) calls Lexical Integrity:²⁶ the susceptibility to T3S of a **word**-internal sequence is the same in all the environments in which the word occurs. 'Word' is crucial here; the generalization becomes false if 'word' is replaced by 'expression', which extends its purview to phrases.

Let us now consider the derivations in (21). (21a) incorrectly predicts that *tong3* can be pronounced with T3, but the

²⁵ All the T3S cycles are conflated into one line, as in (18), and so are those of foot formation.

²⁶ On Lexical Integrity, Chen cites Shih's 1986 Ph.D. dissertation, which was not available to us during the preparation of this paper.

center of interest here is an incorrect prediction of a more general nature, which is that the environment in which the word *zao4 tong3 chang3* occurs may exert an influence on the operation of T3S inside that word. The conditions of Cyclic Branch Blocking (13) are met in (21a) but they are not in (21b) and consequently T3S is obligatory in (21b) while it is only optional in (21a). While *chang3* belongs to a foot in (21a), it remains unfooted in (21b), due to the presence of the locative *wai4*.²⁷ PSC's account of T3S does not contain any device which could enforce Lexical Integrity, and this is illustrated by the derivations in (21).

3.5. Neutralization in stressed syllables?

Chen's (2000) analysis of T3S sandhi in BM relies on syllable groupings which he calls MRUs (for 'Metrical rhythmic units'). Like PSC's feet, MRUs are groupings of a purely phonological nature, they must contain at least two syllables and they are constructed iteratively from left to right whenever they are built over expressions with a 'flat' constituent structure. Unlike PSC's feet, however, MRUs are not organized around a head, and Chen states (p. 375) that they cannot be equated with stress feet.²⁸ Indeed, it is one of the major claims in PSC that the syllable groupings which influence tone sandhi in BM are stress feet. This claim is seriously open to doubt for the following reasons.

Note first that in PSC, while the headedness of feet plays a crucial role in foot formation,²⁹ it is irrelevant to tone sandhi. The workings of PSC's sandhi rules do not depend in any way on the difference between those syllables which are foot heads (i.e. stressed syllables) and the other syllables. The only aspect of foot

²⁷ The foot structure in (21a) accords with (19a) p. 185. The text on the same page explains how the foot (*zao4 tong3*) is allowed to violate Nonhead Stress. The foot structure in (21b) is the same as in (43) p. 250.

²⁸ Chen ends his discussion of the MRUs' theoretical status by suggesting that they are akin to poetic feet.

²⁹ Via Foot Merger (7).

structure that matters for the sandhi rules is the location of foot edges. Foot edges can prevent the obligatory application of T3S rule (10), pursuant to Cyclic Branch Blocking (13), but the conditions of Cyclic Branch Blocking cannot be reformulated in terms of stress (i.e. of head vs. nonhead), because in some cases one of the cyclic branches involved in Cyclic Branch Blocking is not a foot, but a morpho-syntactic constituent.³⁰

Second, if it were the case that the heads of the feet postulated by SD represented stressed syllables, his analysis would run afoul of the cross-linguistic generalization that unstressed positions are more susceptible than stressed ones to neutralization processes. When the T3S rule (10) operates inside a dissyllabic foot of the form (33) and turns it into (23), the syllable whose tone is changed is the head of the foot (feet are left-headed). As T3S is a neutralization, the realization of feet of the form (33) as (23) is a counterexample to the abovementioned generalization. Similarly, when (33)#(33) is realized as (23)#(23), with the second syllable immune from obligatory T3S on account of Cyclic Branch Blocking,³¹ the two stressed syllables in the expression are subject to neutralization, while the medial unstressed syllable retains its underlying tone.

Chao (1968) and Hoa (1983), among others, have claimed that in BM stress is attracted to the right edge of constituents. If they are right, the reason why T3S affects the first of two adjacent T3 tones, rather than the second, could be that the first is more weakly stressed than the second.

SD himself brings up the preference of neutralization processes for unstressed positions, and it is ironic that he does so in a passage (p. 139) where he argues that another tone sandhi process in BM, T2 Sandhi, provides evidence in favor of his analysis of stress:

(22) T2 Sandhi: $T2 \rightarrow T1 / \{T1 T2\} _ T_X$

³⁰ (19b) above is a case in point.

³¹ V. (46) and (49) in (19) above.

When preceded by T1 or T2 and followed by a full syllable with any tone (T_x), T2 merges with T1. In *tuo1 er2 suo3* 'day-care centre', for instance, the tone of the second syllable merges with T1. According to the author, the facts of T2 Sandhi support his analysis of stress, because T2 Sandhi neutralizes the contrast between T1 and T2 in the second syllable of trisyllabic words, and his analysis predicts that in trisyllabic words the second syllable has the least stress. But this is not so: There are trisyllabic words in which SD's analysis predicts that the medial syllable should receive the main stress, and consequently the facts of T2 Sandhi do not provide evidence in favor of his analysis of stress. A case in point is *fwu2[guo2 ji2#]* 'stateless', in which *guo2* is predicted to receive main stress, since it is the non-head in *guo2 ji2*, and *guo2 ji2* is the non-head in the whole compound, a Verb-Object construction. In fast speech T2 Sandhi can also apply to syllables which are predicted to have main stress in phrasal constructions, e.g. to *yang2* in *chi1 [yang2 rou4#]* 'eat mutton' ([eat [sheep meat]]).

T1 is high level (H) and T2 is rising from mid to high (MH). In sequences T1-T2 (H-MH) and T2-T2 (MH-MH), the M of the second syllable is wedged between two H tones, and previous authors have interpreted the change effected by rule (22) as an assimilation of that mid tone to the surrounding high tones.³² But then, what is the motivation for T_x in rule (22), i.e. why is it that the presence of a full syllable is needed after T2 for the assimilation to occur, and yet the tone on that syllable is irrelevant? SD states that 'there is no good answer' to that question (p. 223). Actually, an answer is provided by Chen (2000: 299-306), who argues that various facts about T2 Sandhi are explained by restricting the rule to apply only to weakly-stressed syllables. The presence of a full syllable after the focus of the rule is necessary for T2 to be in a metrically weak position. Chen's analysis of T2 Sandhi is incompatible with SD's system, in which stress may fall on any syllable in a trisyllabic word, depending on constituent structure

³² V. Chen (2000: 300) and references therein.

and on headedness. Far from providing evidence in favor of PSC's analysis of stress in BM, T2 Sandhi turns out to cast doubt on it.

4. ZERO SYLLABLES

One serious weakness in PSC's account of T3S has to do with silent beats (a.k.a. zero syllables). The author never indicates precisely in what environments it is licit to invoke a zero syllable. He merely states that the syllables which form a foot with a silent beat are 'in final position'. Let us assume that what he means by this is 'before a major syntactic boundary'. This raises a serious conceptual problem. Invoking an empty syllable on Cycle 1 in (18) is in contradiction with the very notion of cyclic application: the information available during Cycle 1 concerns only the internal structure of the phrase [*mai3 shu1*], and does not tell us anything about the phrase's surroundings, e.g. whether its right edge is a major syntactic break. This is another respect in which SD's use of cyclic rules is radically at variance with the standard conception of the cycle.

On the empirical side, one problem is the following incorrect prediction: When a left-headed phrase of the form [[33]3] is 'in final position', its second syllable should never be subject to obligatory T3S. A case in point is the phrase (23a) below,³³ whose only licit realization is 223 (v. (5) p. 238). According to SD's account, the final outcome of cyclic foot formation would be (23b), with the two syllables in the inner constituent left unfooted.

(23a) ɤ ɤmai3 hao3] jiu3] (23b) [mai3 hao3] # (jiu3 Ø)

When (23b) is subjected to the tone sandhi rules, Cyclic Branch Blocking (13) will prevent rule (10) from obligatorily

³³ [[buy finish]wine] 'finished buying wine'.

changing to T2 the tone of *hao3*, for *hao3* and *jiu3* belong to two non-overlapping cyclic domains, respectively a phrase and a foot.³⁴

There is another, more general empirical problem lurking behind zero syllables. The examples discussed in the book can all be interpreted as involving silent beats which are in sentence-final position, except in two passages where the author assumes that silent beats are also optionally available before major syntactic boundaries inside sentences. On p. 252 the phrase *xiang3 MAI3 gu3-piao4* 'want to BUY (not sell) stocks' is assigned two alternative foot structures, the second of which is represented below in (24):

| | |
|--------------|-----------------------------|
| (24) | xiang3 (MAI3 Ø) (gu3 piao4) |
| output tones | 2 3 3 4 |

In (24) *MAI3* is a dissyllabic foot unto itself, due to the following silent beat, and it is not subject to the obligatory application of T3S rule (10). SD does not say what insulates the tone of *MAI3* from that of *gu3*: the intervening zero syllable, Cyclic Branch Blocking, or both? In any case, as this example should make clear,³⁵ zero syllables are a very powerful device, and an analysis which employs them must indicate in what contexts they are allowed to occur. As SD is silent about intonational phrasing, it is not clear whether his zero syllables can be equated with breaks between Intonational Phrases.

5. UNSTRESSED SYLLABLES AND SYLLABLES WITH WEAK STRESS

Some of the evidence SD invokes in favor of his account of stress in BM has to do with differences between full syllables and

³⁴ If the syntactic head in *mai3 hao3* is taken to be *hao3* rather than *mai3*, the final output of foot formation still meets the conditions of (13), with *mai3* and *hao3* forming a cyclic domain which is a foot, rather than a phrase as in (23b).

³⁵ The other example involving a sentence-internal zero syllable is (50c) p. 251.

weak syllables, v. section 6.4.2, which is entitled 'The locations of stress and weak syllables' (pp. 137-139).

Whereas elsewhere in the book the expression 'weak syllable' refers to reduced syllables (a.k.a. 'neutral-toned syllables'),³⁶ the discussion in section 6.4.2. lumps together reduced syllables³⁷ and full syllables which are weakly stressed on account of their position in an expression, e.g. *xi1* in *da4 xi1-hong2-shi4* 'large tomato' (p. 139). This obscures a basic difference between the two types of syllables: whereas a full syllable may be strongly stressed in one environment and weakly stressed in another, reduced syllables must be weakly stressed in all their occurrences. The difference is akin to that between syllables with secondary stress and unstressed syllables in English. The Rhythm Rule can shift the main stress in a word to the former, but not to the latter, e.g. the first syllable in *fifteen*, which only has secondary stress when the word is uttered in isolation, gets primary stress in *fifteen summers*, whereas the first syllable in *serene*, which is unstressed, must remain unstressed in *serene summers*.³⁸ Let us first focus on the difference between full syllables taken en bloc, regardless of stress differences among them, and reduced syllables.

Full syllables are perceptually more prominent and phonetically longer than reduced ones. In PSC this follows from two claims: (i) full syllables have two moras whereas reduced ones have only one (p 81, 88), and (ii) only bimoraic syllables can be the head of a foot, i.e. be stressed (p. 130).

While full syllables can appear in any position in a word, reduced syllables have a more restricted distribution. Despite its title and its opening sentence, section 6.4.2 fails to indicate how this difference follows from the proposed analysis. Take for instance the fact that a word cannot begin with a reduced syllable. Suppose an input beginning with a one-mora syllable were subjected to PSC's

³⁶ V. notably p. 42-43, 81, 88, 224, 230.

³⁷ V. *yi4 si0* 'token of gratitude', *xian1 sheng0* 'Mister' (p. 139).

³⁸ Halle and Vergnaud (1987: 270).

foot formation procedure. That procedure would simply leave the initial reduced syllable unfooted.³⁹ What is needed, then, is some way of barring reduced syllables from occurring word-initially in underlying representations.⁴⁰

The distribution of reduced syllables is at present the only data which could be interpreted as evidence that BM has left-headed feet. That evidence is not compelling, however, as is shown by the situation in Xiamen, a dialect which has right-headed feet, according to Duanmu (1995). It is well-known that Xiamen has neutral-toned syllables which closely resemble those in BM (see, e.g., Yuan 1983: 247-249).⁴¹ They are subject to processes of consonant weakening and syllable merger which are typical of weakly stressed positions, and their distribution is that of enclitics, as in BM. The Xiamen dialect shows that right-headed feet can coexist with reduced syllables which are enclitics. Consequently the neutral-toned syllables of BM do not force us to conclude that BM has left-headed feet.⁴²

While native speakers of BM agree in perceiving full syllables as more prominent than reduced ones, they often find it difficult to compare full syllables among themselves for prominence, and this is reflected in the diversity of the proposals concerning stress in the literature on BM.⁴³ The relative prominence

³⁹ For examples with syllables left unfooted in the final output, v. (40), (43), (45), (48), (50) and (52) in pp. 249-252.

⁴⁰ Yip (2002: 185) proposes a solution to this problem in an Optimality Theory framework. In the presentation of her proposal, she takes for granted that in BM 'feet are always left-headed'. Elsewhere in her book, the only independent evidence for that claim is her discussion of T3S in relation with recent claims about the interaction between tone and prominence (pp. 97-98). However suggestive, this discussion can't clinch the matter, in the state of our present knowledge about tone.

⁴¹ V. pp. 82-84 and 101-113 in Li (1962) for a comprehensive review of the neutral tone in Xiamen.

⁴² This argument would lose its force if Xiamen could be reanalyzed as having left-headed feet. None has yet shown how the facts of Xiamen can be made compatible with left-headed feet.

⁴³ V. Chen (2000: 286-291) for a thoughtful review of the recent literature on stress in BM.

judgements reported in the literature usually concern words or short phrases uttered in isolation. To my knowledge, the only large-scale exception is Hoa (1983), a comprehensive study of stress in BM based on the relative prominence judgements of the author, a native speaker of the Beijing dialect. Many examples in that study are complete sentences. Hoa's work is summarily dismissed on p. 134,⁴⁴ but it may be premature to write off prominence judgements by native speakers as a source of data. Hazy though these judgements may often be, there are cases in which they give rise to clear-cut minimal pairs. For instance (Hoa 1983: 102), the Verb-Noun sequence *fan1-yi4 shi1-gel* can be either a compound noun ('translated poem'), in which case *fan1* is more prominent than *gel*, or a Verb Phrase ('translate poems'), in which case it is *gel* which is more prominent than *fan1*.⁴⁵

A later passage in PSC points to another source of data. In a short discussion of destressing, the process whereby full syllables become reduced when weakly stressed, SD writes about a corpus of connected speech in which 'about one-third of all syllables are unstressed and toneless'.⁴⁶ According to SD (p.c.), this count was based on F0 trackings. One would like to know how well the distribution of destressed syllables in connected speech squares with the predictions made by PSC's analysis of stress.

⁴⁴ SD writes (p. 134) 'according to Hoa (1983) [...] stress in Standard Chinese is sensitive to tone, in that a syllable with a higher tone is perceived to have more stress'. This is a misleading way of summarizing Hoa's position. According to Hoa, the main determinants of stress in BM are morpho-syntactic structure, focus structure and various requirements of eurhythmy. Tone only plays a very marginal role in her discussion: she points out several cases in which, all other things equal, T3 syllables are averse to stress, v. e.g. Hoa (1983: 79-82, 98-99).

⁴⁵ Hoa claims that contrastive stress is involved, but such pairs may as well be taken as evidence for the Nonhead stress rule. The same is true of some other data in her review of the stress patterns associated with various syntactic constructions, see especially pp. 99-106.

⁴⁶ P. 257. The language recorded in that corpus is Standard Chinese as spoken in Taiwan.

6. OTHER DIALECTS

According to SD, one reason for preferring his analysis to previous ones is that '[it] offers better foot structure, independently supported by tone sandhi in other Chinese dialects' (p. 254).

The author gives only one example to illustrate his claim, a sentence in which the distribution of foot boundaries is claimed to be the same in BM as in Shanghai and Nantong.⁴⁷ The backdrop for this appeal to cross-dialectal similarities is SD's attempt to propose a set of general assumptions under which some of the differences between tone sandhi in BM and in northern Wu dialects would follow from differences in their syllable structures (v. p. 260-1 and Duanmu (1999)). The reasoning underlying that attempt is in serious risk of being circular unless each dialect is first analyzed on its own terms. When SD writes (p. 253) that 'evidence from such dialects [as Shanghai] supports the present analysis [of stress in BM]', how should one interpret that statement? In what sense can one say that the left-headed feet in Shanghai Chinese are evidence in favor of left-headed feet in some other dialect?

In principle, the only data which are relevant for choosing between competing grammars of a given language are those which can play a role in shaping the native speakers' mental grammars during language acquisition. Data from other languages can turn out to be relevant, in which case the reasons why they are relevant can be made explicit. I fail to see these reasons in the case of SD's account of stress in BM. Surely, the fact that BM and Shanghai Chinese are languages with a common ancestor is not sufficient grounds for assuming that their stress systems are similar in this way or that.

Consider for instance the fact that in BM, according to SD's account, stress assignment is blind to the distinction between

⁴⁷ V. (53) p. 253. Comparison with (45) p. 251 shows that in BM, although the verb *mai* in (53) is wedged between two feet, it remains unfooted, which is not the case in Shanghai.

compounds and phrases, while that distinction has an influence on stress in Shanghai.⁴⁸ Can one say that the sensitivity of Shanghai stress to the compound/phrase distinction is evidence against SD's analysis of stress in BM? And can one say that the left-headed feet that Duanmu (1995) posits for Shanghai Chinese are evidence against the right-headed feet that he posits for Xiamen Chinese in the same article?

To sum up: Until reasons to think otherwise are laid out, the facts of foot formation in Shanghai are not relevant for choosing between competing accounts of stress in BM. Whatever the adequacy of left-headed feet for Shanghai Chinese, it does not alleviate the defects in PSC's account of BM.

7. VERSIFICATION

SD claims that classical poetry provides evidence in support of his analysis of stress (p. 142). He equates the dissyllabic feet of poetry with stress feet and he illustrates his claim with two lines from a poem composed in the eighth century AD.⁴⁹ However he does not explain why eighth century versification should provide clues to the stress system of a present-day dialect.

8. CONCLUSION

According to PSC, stress in BM is characterized by left-headed feet, but all the phonological arguments given in the book to support that claim dissolve under examination. Some of the facts adduced as evidence are irrelevant (§ 6, 7) and others are compatible with right-headed feet as well (§ 5). While Tone 3 Sandhi is presented as a major item of evidence in favor of PSC's analysis of stress, the role played by stress in PSC's account of Tone

⁴⁸ V. e.g. Duanmu (1995).

⁴⁹ I thank Yau Shun-chiu for identifying the poem in question, which is by Li Bo.

3 Sandhi is not as important as might appear at first blush (§ 3.2, 3.3). More importantly, PSC's cyclic rules of foot formation and of tone sandhi suffer from serious inadequacies, conceptual as well as empirical. Besides an inconsistency involving Foot Merger (7) (v. § 2), PSC's system implies two important changes in the conception of the phonological cycle. These changes, whose adoption is not made explicit, concern the interaction of cyclic rules (Feet All Over First, see § 3.2 and 3.3) and the way zero syllables are invoked during cyclic foot formation (§ 4).⁵⁰ On the empirical side, PSC's account of stress and tone sandhi makes Standard Chinese a counter-example to the cross-linguistic tendency of neutralization processes to prefer weakly-stressed positions (§ 3.5), and it lacks the means to enforce Lexical Integrity (§ 3.4).

For those who want to obtain a first idea of what is presently known about stress in Standard Chinese, a better starting point is Chen (2000).

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⁵⁰ An additional conceptual problem is the non-Markovian nature of the optional T3S rule (11), as the observant reader will have noticed.

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