On Tone Sandhi in Chinese (Putonghua)

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Recommended Citation

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Chinese (Putonghua[1]) has one major tone sandhi rule (the Tone 3 Sandhi Rule) which has been much discussed in the literature, but there still remain a number of problems concerning its method of application and its interaction with other rules. In this paper we shall argue for a solution along the lines of Lexical Phonology, positing that with respect to tone sandhi, rules apply in two modes, the Lexical Mode and the Post-Lexical Mode.In each mode a similar set of rules apply, though in somewhat different order. In the Post-Lexical Mode, the tone sandhi rule applies simultaneously and not in cyclical fashion.Using this approach we shall also show the different sources of toneless elements.

1. Introductory Remarks on Chinese Tones

Chinese (Putonghua) is a tone language with four lexical tones. The tones have the function of distinguishing lexical meanings and are specified for each lexical entry in the lexicon.The four tones are traditionally given as follows:

(1) Name   Contour   Representation Ex. Gloss

Tone 1 high level   — $m\bar{a}^2$ mother

Tone 2 rising   /   má hemp

Tone 3 fall-rise   ⌄   mǎ horse

Tone 4 falling   \   mà scold

If we mark the pitch range of our voice with a five-degree scale, with 5 as the highest pitch and 1 as the lowest, the four tones have approximately the following values in citation form:

(2)   Tone   Pitch Value
           Tone 1   55
           Tone 2   35
           Tone 3 214^3
           Tone 4   51

The four above-mentioned tones all refer to stressed syllables. Unstressed syllables, however, have no independent tone of their own, their pitch values being determined by the tones of the preceding syllables, as in (3):

(3) Tone of   Pitch Value of Example Gloss
    Preceding Unstressed
    Syllable   Syllable
    Tone 1   3   tiānqi   weather

    Tone 2   3   fúqi   luck

    Tone 3   4   xiǎoqi   stingy

    Tone 4   1   kèqi   polite

The morpheme qi has Tone 4 in citation form qì as well as in words like qìtǐ (gas) or qìqíu (balloon). But in the above examples, it is unstressed and loses its original tone (Tone 4). We would regard such a morpheme (i.e. a morpheme with no tone of its own) as a toneless element and represent its tone as $\emptyset$ (traditionally called neutral tone)[4]. In the above example, the morpheme qi loses its tone through a rule which we call the Tone Deletion Rule, formulated as in (4):

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(4) Tone Deletion Rule

   Tone $\longrightarrow \emptyset$
   (-Stress)

2. A First Look Into Tone Sandhi Rule Application

By tone sandhi we mean the change from one tone
to another under the influence of a neighbouring tone.
The most significant and most discussed tone sandhi in
Chinese (Putonghua) is Tone 3 sandhi, i.e. the change of
Tone 3 to Tone 2 when it precedes another Tone 3. We
can represent this as the rule in (5). As this rule will
be the only tone sandhi rule to be discussed in the
present paper, we will simply call it the Tone Sandhi
Rule for convenience.

   (5) Tone Sandhi Rule

      $3 \longrightarrow 2/ \underline{\quad} 3$
      where 3 represents Tone 3 and 2 represents
      Tone 2

Consider the word <u>biaojie</u> (elder female cousin).
In citation form both <u>biao</u> and <u>jie</u> bear Tone 3, but
when <u>biao</u> precedes <u>jie</u>, the Tone Sandhi Rule applies,
and <u>biao</u> changes from Tone 3 to Tone 2, as in (6):

   (6)   biaojie
          Lexical
          Specification   3 3

          Tone Sandhi   2 3

But what would happen if there is a sequence of
more than two Tone 3 syllables? Would the Tone Sandhi
Rule apply cyclically or otherwise?
   Consider the sequences in (7):

   (7) a.   biaojie hao (good)
          Lexical
          Specification   3 3   3

          Surface Form   2 2   3

        b.   hao biaojie
          Lexical
          Specification   3   3 3

          Surface Form   2   2 3

In what fashion should we apply the Tone Sandhi

Rule to derive the correct surface forms? Let us first
apply the Tone Sandhi Rule cyclically, as in (8):

(8)   a.   ((biaojie) hao)
        Lexical
        Specification   ((3   3)   3)

        Tone Sandhi(1st cycle)   (2   3   3)

        Tone Sandhi(2nd cycle)   2   2   3

        b.   (hao (biaojie))
        Lexical
        Specification   (3   (3   3))

        Tone Sandhi(1st cycle)   (3   2   3   )

        Tone Sandhi(2nd cycle)   3   2   3

From the above we can see that the Tone Sandhi
Rule can be applied to left-branching structures (8a).
But cyclical application to right-branching structures
(8b) would not yield the anticipated results. So it
seems that the Tone Sandhi Rule can not be applied
cyclically.
       Cheng(1973) proposed simultaneous application
(as in SPE) in applying the Tone Sandhi Rule. In simul-
taneous application, you scan the entire string for
segments that satisfy the rule. After all such segments
have been identified, the rule is applied to all the
segments concerned. In this way we can get the correct
surface form 2 2 3 of both hao biaojie and biaojie hao,
as shown in (9):

(9)   a.   biaojie   hao
        Lexical
        Specification   3   3   3

        Scanning   YES YES   NO

        Tone Sandhi   2   2   3

        b.   hao   biaojie
        Lexical
        Specification   3   3   3

        Scanning   YES   YES NO

        Tone Sandhi   2   2   3

Yip(1980) advocated a percolation theory, which is

                                                                    4

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briefly as follows. She proposes that each tone consists
of two hierarchical binary features, the Register and the
Tone features, as in (10):

(10)	Register	Tone Feature
	+Upper	+High (H)
		-High (L)
	-Upper	+High (H)
		-High (L)

    In her system Tone 2 has the Register feature
(+Upper) and Tone features LH, while Tone 3 has the
Register feature (-Upper) and Tone features LH. Thus
the Tone Sandhi Rule which change Tone 3 to Tone 2 is
essentially the change of the dominating Register
(-Upper) to (+Upper), as formulated in (11):

(11)   (-Upper) $\longrightarrow$ (+Upper) / _____ (-Upper)

    According to her percolation theory, the (-Upper)
on a node in a tree percolates to the next higher node
and so on up to the top, as in (12):

(12)
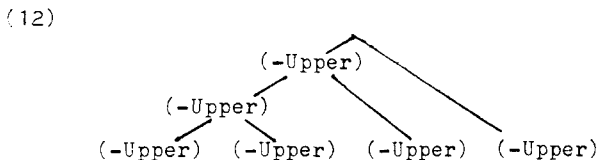
    Rule (11) applies not to terminal nodes but at
the highest possible level followed by conventional
percolation, in this downwards. A single application
will therefore effect a change in a sequence of terminal
nodes without problem. Applying this to both biaojie
hao and hao biaojie we get their correct surface forms,
as in (13):

(13)
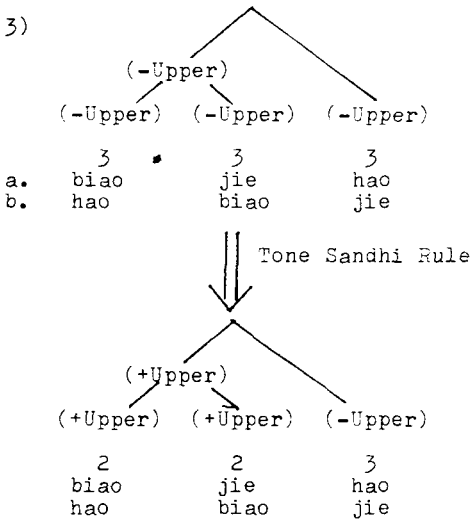
So it seems that both Cheng's simultaneous application and Yip's percolation theory are satisfactory solutions to the problem of how the Tone Sandhi Rule is to be applied.

But when the Tone Sandhi Rule interacts with the Tone Deletion Rule and toneless elements get involved, they don't seem to cope so well.

3. Tone Sandhi and Tone Deletion: A Puzzle

Now consider the word xiaojie (term used to refer to or to address an unmarried woman, approximately equivalent to 'Miss' in English). The word consists of two syllables xiao and jie, both being Tone 3 in citation form. But the surface form of xiaojie is 2 Ø. How do we account for that?

One approach would be to posit that jie has two tone specifications in the lexicon, Tone 3 and Ø. Thus it can be said that the Tone 3 of jie in biaojie and the toneless property of jie in xiaojie are both due to specification in the lexicon. But then xiao (which has Tone 3 in underlying form) would precede Ø and there would be no grounds for the Tone Sandhi Rule to apply. Consequently we would not be able to explain why xiao has its tone changed from Tone 3 to Tone 2. A more plausible approach would be to assume that jie has only one tone specification (Tone 3) in the lexicon and that this tone is deleted

by the Tone Deletion Rule (4). Thus we can get the
correct surface form of <u>xiaojie</u> by applying the Tone
Sandhi Rule and the Tone Deletion Rule in successive
order, as in (15):

(15)   xiaojie
            Lexical
            Specification   3   3

            Tone Sandhi   2   3

            Tone Deletion   2 · ∅

Note that in order for the above rules to apply,
<u>jie</u> in <u>xiaojie</u> should be specified (-Stress) in the
lexicon besides being specified Tone 3, as in (16):

(16)   xiaojie
            Lexical
            Specification   3   3
                                    (-Stress)

Note also that the Tone Sandhi Rule must apply
before the Tone Deletion Rule to get the correct
results. If the Tone Deletion Rule applies first, then
we would get an incorrect surface form, as in (17):

(17)   xiaojie
            Lexical
            Specification   3   3
                                    (-Stress)
            Tone Deletion   3   ∅

            Tone Sandhi   3   ∅
                                  (rule not applicable)

Now consider the expression <u>hao xiaojie</u>, whose
surface form is 3 2 ∅. How can we derive this surface
form from the underlying form 3 3 3?
    Let's try Cheng's simultaneous application first.

(18)   hao xiaojie
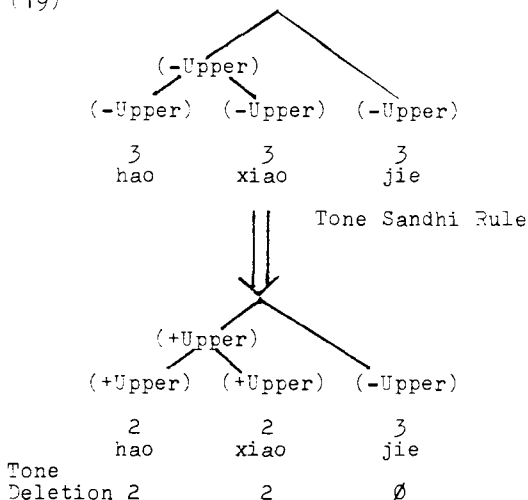   Lexical
            Specification   3   3   3

            Scanning   YES YES NO

            Tone Sandhi   2   2   3

            Tone Deletion   2   2   ∅

simultaneous approach and then applying the Tone
Deletion Rule, we get the incorrect form 2 2 Ø.

Now let's try Yip's percolation approach, as
in (19):

(19)

This is the same as what we get from Cheng's
simultaneous application and is also incorrect.

Now the puzzle is why does Cheng's simultaneous
application and Yip's percolation theory work so well
with **hao biaojie** and fail to derive the correct sur-
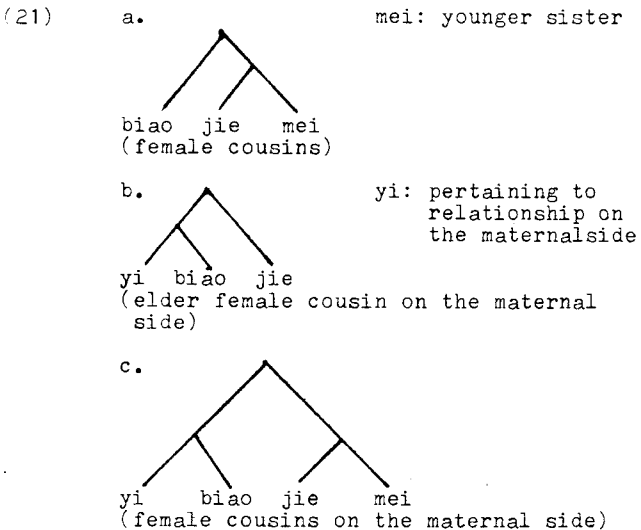face form of **hao xiaojie**? What explanation can we
offer?

4. Two kinds of compounds

At first sight **hao biaojie** and **hao xiaojie** seem
to have the same structure, both being right-branching
structures, as in (20):

(20)   a.   b.

        hao   biao   jie   hao   xiao   jie

Besides, both biaojie and xiaojie are compounds,
the former being made up of the morpheme biao (per-
taining to cousinship) and jie (elder sister)and the
latter being made up of the morphemes xiao (small)
and jie (elder sister). On closer examination, however,
we find that there are significant differences between
the two compounds. First, the meaning of biaojie
(elder female cousin) is a function of the meaning
of its component parts, but the meaning of xiaojie
(term to refer to or to address an unmarried woman)
is not determinable from the meaning of its parts.

Secondly, in the case of biaojie, each of its
parts can combine with another element to form a new
constituent, as in (21):

(21)   a.   mei: younger sister

        biao   jie   mei
        (female cousins)

        b.   yi: pertaining to
                                       relationship on
                                       the maternalside

        yi   biao   jie
        (elder female cousin on the maternal
         side)

        c.

        yi   biao   jie   mei
        (female cousins on the maternal side)

Structures (19b) and (19c) analyse yi biao as
belonging to one constituent. This analysis can be
justified by the following sentences:

(22) a. yi biao buneng jieqin.
(Cousins related on the maternal side
can't get married.)

*b. tamen jiemei shi yibiao.
(They are female cousins related on the
maternal side.)

From the above we can conclude that biao and
jie are loosely structured since each can combine
with other morphemes to form new constituents. But
with xiaojie, the situation is quite different. Its
two component parts are very tightly structured to-
gether and can not be separated into two different
constituents.Consider the structures in (23):

(23)   a.   *b.   da: big,elder

    da xiao jie   da xiao jie

The structure (23a) with xiaojie forming one
constituent is grammatical, and the expression is used
to refer to the eldest unmarried lady of the family,
but the structure (23b), which puts xiao and jie in
two separate constituents is ungrammatical.This shows
that the relation between biao and jie in biaojie is
loose and of a syntactic nature, while that between
xiao and jie in xiaojie is tight and of a lexical
nature.

Another major difference between biaojie and
xiaojie lies in their different stress patterns.
Biaojie has a 21 stress pattern, whereas the stress
pattern of xiaojie is 10.[6]

From the above we can see that biaojie and
xiaojie show differences in compositionality of
meaning, morpheme structure and stress pattern. We
could thus classify them into two different types of
compounds, which we will call syntactic compounds
and proper lexical compounds. I am calling the later
type proper lexical compounds instead of lexical
compounds to stress the fact that they should have all
the three properties mentioned above,i.e. non-compo-
sitional meaning, tight morphemic structure and stress
pattern 10.

It would of course be ideal if all compounds

10

with the first two properties (i.e. non-compositionality and tight morphemic structure) would also have the stress pattern 10. But that is not the case. Chao (1968), Woo(1969),Cheng(1973) and Yip(1980) all argue that that are a number of words with stress pattern 10 which are not derivable by rule or accountable by other morphological reasons, but should be specified in the lexicon. I agree with them and posit that words like xiaojie have their pattern specified 10 in the lexicon, the second morpheme being specified (-Stress).

5. Two Modes

Having distinguished between proper lexical and syntactic compounds, we posit that with respect to tone sandhi and tone deletion, rules apply in two 'modes', the Lexical Mode and the Post-Lexical Mode. The domain of the Lexical Mode will be proper lexical compounds and reduplication words (which we will deal with in a moment), while that of the Post-Lexical Mode will be the phonological phrase including sentences, phrases and syntactic compounds'. Thus the Lexical Mode is a domain in which the Tone Sandhi Rule and the Tone Deletion Rule apply in a cycle before going on to the Post-Lexical Mode, as shown in (24):

(24)   Lexical Mode
            Tone Sandhi Rule
            Tone Deletion Rule
         Post-Lexical Mode
            Tone Sandhi Rule

Using this two-mode approach we can now derive the correct surface forms of hao biaojie and hao xiao-jie, as in (25):

(25) a. $((hao)_L \ (biao)_L \ (jie)_L)_{PL}$
        Lexical
        Specification   3   3   3
     Lexical Mode
        Tone Sandhi   3   3   3
        Tone Deletion   3   3   3
     Post-Lexical Mode
        Tone Sandhi   2   2   3

(25) b. $((hao)_L$ $(xiaojie)_L)_{PL}$

    Lexical
    Specification   3   3 3
                                      (-Stress)
    Lexical Mode
      Tone Sandhi   3   2 3
      Tone Deletion   3   2 Ø
    Post-Lexical Mode
      Tone Sandhi   3   2 Ø

Note that the Tone Sandhi Rule applies in both
modes, but in the Post-Lexical Mode it is not applied
cyclically, but simultaneously, i.e. according to
Cheng's simultaneous approach and Yip's percolation
theory.

In Chinese there are certain syntactic configur-
ations in which certain elements lose their stress.
For instance, in a verb phrase (VP) when the object to
the verb is a personal pronoun, it will lose its
stress. Consider the following sentence:

(26)   <u>ta</u> <u>da</u>   <u>wo</u>
        he hit I
        (He hit me.)

In sentence (26), the pronoun <u>wo</u> is the object to
the verb <u>da</u> in the VP <u>da</u> <u>wo</u>, and therefore loses its
stress. This can be formulated as the rule in (27):

(27)   Pronoun Object Stress Deletion Rule

    Stress $\longrightarrow$ -Stress / $(V (\underline{})_{Pron})_{VP}$

This rule belongs to a set of rules called the
Syntactic Stress Deletion Rules (which we are not
going to elaborate on in this paper, for further dis-
cussion of syntactic stress deletion, see Cheng(1959),
Lin(1962), Chao(1968)). After the application of these
rules, we can then apply the Tone Deletion Rule (4)
to delete the tones of the elements which have lost
their stress. Now we have the following schema:

(28)   Lexical Mode
      Tone Sandhi Rule
      Tone Deletion Rule
    Post-Lexical Mode
      Tone Sandhi Rule
      Syntactic Stress Deletion Rules
      Tone Deletion Rule

Using this rule schema we can derive the correct surface form of a sentence like li xiaojie da wo ("Miss Li hit me. Surface form 3 2 Ø 2 Ø), as in (29):

(29)

	$((li)_L$	$(xiaojie)_L$	$(da)_L$	$(wo)_L)_{PL}$
Lexical Specification	3	3 3 (-Stress)	3	3
Lexical Mode				
Tone Sandhi	3	2 3 (-Stress)	3	3
Tone Deletion	3	2 Ø	3	3
Post-Lexical				
Tone Sandhi	3	2 Ø	2	3
Stress Deletion	3	2 Ø	2	3 (-Stress)
Tone Deletion	3	2 Ø	2	Ø

6. Reduplication

Now let us take reduplication into the picture. First consider the cases in (30):

(30)		Gloss	Surface Form	
	nainai	grandmother	3	Ø
	zouzou	take a walk	2	Ø
	ben ben	every copy	2	3

The three morphemes nai, zou and ben are all specified Tone 3 in the lexicon, but their reduplications have quite different surface forms. This seems confusing, but when we put them into the context of the two-mode approach, things smooth out very well.

Nainai is a noun formed by reduplication of the morpheme nai. The meaning of the word nainai is not determinable by the function of the reduplication of the morpheme nai (which means 'milk'). The meaning of zouzou (to take a walk) is discernable from the meaning of the morpheme zou (which means 'walk') and the function of the reduplication which signifies an instance of the action referred to by the reduplicated morpheme. Besides, the structure of the compound zouzou is loose and of a syntactic nature, as we can insert yi (one) or le (perfective aspect marker) in between, obtaining zouyizou ('take a walk', more colloquial than zouzou) and zoulezou (have taken a walk). But nainai has a tight structure, which is of a lexical nature, and we can not insert any element between the first nai and the second nai. Thus we distinguish

between two types of reduplication compounds: 1)
lexical reduplication compounds (with the properties
of non-compositionality of meaning and tight morphe-
mic structure, and consisting of word like <u>nainai</u>),
and 2) syntactic reduplication compounds (with the
properties of compositional meaning and loose morphe-
mic structure, and consisting of words like <u>zouzou</u>).
We can now put the Lexical Reduplication Compounds
in the Lexical Mode and the Syntactic Reduplication
Compounds in the Post-Lexical Mode.

We posit that both types of compounds are formed
by a reduplication rule, which we formulate as (31):

(31)   Reduplication Rule

        $$\begin{array}{ccc} T & \longrightarrow & T \quad T \\ x & & x \quad x \end{array}$$
        where T represents Tone and x represents
        a tone-bearing syllable

Since the second morpheme of both types of
compounds is toneless, we conclude that the second
syllable of both types of compounds is unstressed.
Thus we need a stress deletion rule, formulated as
(32):

(32)   Reduplication Stress Deletion Rule

        Stress $\longrightarrow$ -Stress $/(_{-Stress}^{x})(\underline{\quad}^{x})_{WORD}$

Both rules apply in the Lexical Mode and also in
the Post-Lexical Mode, and interact with the tonal
rules. However, there is a different ordering of the
rules in the two modes. In the Lexical Mode, The Tone
Sandhi Rule applies before the Reduplication Rule
and we get Schema (33):

(33)   Lexical Mode
        Tone Sandhi Rule
        Reduplication Rule
        Reduplication Stress Deletion Rule
        Tone Deletion Rule

This would give the correct surface form for
<u>nainai</u>, which is 3 Ø, as in (34):

```
(34)                                    nai
         Lexical Specification          3
      Lexical Mode
         Tone Sandhi Rule               3
         Reduplication                  nainai
                                        3  3
         Reduplication Stress Del.      3  3
                                             (-Stress)
         Tone Deletion                  3  Ø
```

Note that the Reduplication Rule can not apply
before the Tone Sandhi Rule in the Lexical Mode.
Otherwise we would get the incorrect surface form 2 Ø
for <u>nainai</u>, as in (35):

```
(35)                                    nai
         Lexical Specification          3
      Lexical Mode
         Reduplication                  nainai
                                        3  3
         Tone Sandhi                    2  3
         Reduplication Stress Del.      2  3
                                             (-Stress)
         Tone Deletion                  2  Ø
```

In the Post-Lexical Mode, however, the Redupli-
cation Rule comes before the Tone Sandhi Rule. The
rule schema for the Post-Lexical Mode is as in (36):

```
(36)  Post-Lexical Mode
         Reduplication Rule
         Tone Sandhi Rule
         Reduplication Stress Deletion Rule
         Syntactic Stress Deletion Rule
         Tone Deletion Rule
```

With this ordering we can get the correct form
2 Ø for <u>zouzou</u>, as in (37):

```
(37)                                    zou
         Lexical Specification          3
      Post-Lexical Mode
         Reduplication                  zouzou
                                        3  3
         Tone Sandhi                    2  3
         Reduplication Stress Del.      2  3
                                             (-Stress)
         Syntactic Stress Del.          2  3
                                             (-Stress)
         Tone Deletion                  2  Ø
```

If the rules in the Post-Lexical Mode were ordered in the same way as in the Lexical Mode (i.e. Tone Sandhi before Reduplication), then we would not be able to get 2 ∅ for zouzou.

Now we turn to ben ben, whose surface form is 2 3. Ben ben is a reduplication of the word ben (copy), and means 'every copy'. In Chinese a noun denoting a concrete object or a measure word denoting a unit can be reduplicated to form a noun phrase expressing the meaning of universality (every). So ben ben is a noun phrase and not a compound word like nainai or zouzou. Therefore the Reduplication Stress Deletion Rule, which has the word as its domain, is not applicable. That's why the stress of the second ben is not deleted and it retains Tone 3, as in (38):

> (38) Lexical Mode (omitted)
> Post-Lexical Mode
> Reduplication   ben ben
>   3   3
> Tone Sandhi   2   3
> Reduplication Stress Deletion   2   3
> Syntactic Stress Deletion   2   3
> Tone Deletion   2   3

From the above discussion we see that the different surface forms of reduplications can be accounted for by their classification into lexical and syntactic types and being assigned to two different modes. This further argues for the establishment of two modes of rule application, which was based on the analysis of the two different types of compounds discussed in Section 4.

To sum up, the complete set of tonal rules in the two modes is as follows:

> (39) Lexical Mode
> Tone Sandhi Rule
> Reduplication Rule
> Reduplication Stress Deletion Rule
> Tone Deletion Rule
>
> Post-Lexical Mode
> Reduplication Rule
> Tone Sandhi Rule
> Reduplication Stress Deletion Rule
> Syntactic Deletion Rule
> Tone Deletion Rule

        The above schema shows that the tonal rules
which apply in the Lexical Mode and the Post-Lexical
Mode are precisely the same (except for an extra set
of syntactic stress deletion rulesin the Post-Lexical
Mode) and constitute a single unitary system. They
are, however, arranged in somewhat different order and
applied in different fashion, which accounts for a
number of otherwise puzzling surface forms. And while
all rules in the Lexical Mode are obligatory, some of
the rules in the Post-Lexical Mode are optional,
depending on whether your speech is formal or casual
and also on the speed of speech. For instance, in
very formal style and slow speed, The Reduplication
Stress Deletion Rule can be optional in the Post-
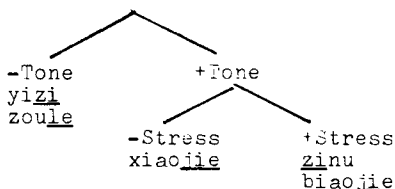Lexical Mode, giving the surface form 3 $\emptyset$ for zouzou.

7. Some Remarks on Toneless Elements

        From the above discussion we have seen that
toneless elements in Chinese do not all originate
from a single source, but are the output of various
rules in the two-mode schema. Apart from that, there
are also certain suffixes and syntactic markers which
are specified toneless in the lexicon, such as the
suffix zi and the aspect marker or sentence particle
le. Note that to be specified toneless (-Tone) in the
lexicon is different from being specified (-Stress)
in the lexicon. Take the word xiaojie for instance.
The morpheme jie in this word is specified Tone 3
and (-Stress) in the lexicon, thus yielding the correct
surface form 2 $\emptyset$, as shown in (15) and (16). If jie
were specified toneless in the lexicon, then xiaojie
would invariably be 3 $\emptyset$, and there would be no way
to derive the correct surface form 2 $\emptyset$. On the other
hand, the surface form of yizi(chair) is 3 $\emptyset$, which
is identical with its lexical specification, yi being
specified Tone 3 and zi toneless in the lexicon. If
zi were specified Tone 3 and (-Stress) in the lexicon,
then we would get the incorrect surface form 2 $\emptyset$ and
not 3 $\emptyset$, as shown in (40):

        (40)   yizi
                Lexical specification   3 3
                                               (-Stress)

            Lexical Mode
                Tone Sandhi   2 3
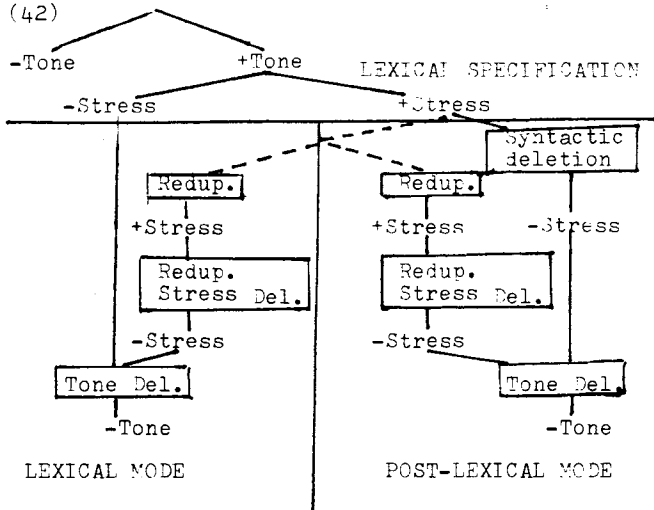   (-Stress)

                Reduplication
                Reduplication Stress Del.
Tone Deletion   2 $\emptyset$

We can represent the relationship between (-Tone)
and (-Stress) with the following schema of lexical
specification:

(41)

```
                       /\
                      /  \
                 -Tone    +Tone
                 yizi    /\
                 zoule  /  \
                   -Stress   +Stress
                   xiaojie   zinu
                             biaojie
```

In surface form toneless elements are always
unstressed, yet in underlying form and in their
derivational history, the relationship between tone
and stress is more complicated. Some toneless elements
are specified (-Tone) in the lexicon (as zi which
has been discussed above), others are the output of
the Tone Deletion Rule. In this respect the input
to the Tone Deletion Rule may be an element specified
(-Stress) in the lexicon or it may be the output of
various stress deletion rules. The sources of toneless
elements and the relation between stress and tone
can be represented by the following diagram:

(42)


```
                 /\
                /  \
           -Tone    +Tone        LEXICAL SPECIFICATION
          /        /    \
      -Stress   -Stress  +Stress
                          ┌──────────┐
                          │Syntactic │
                          │deletion  │
                          └──────────┘
         ┌───────┐   ┌───────┐
         │Redup. │   │Redup. │
         └───────┘   └───────┘
        +Stress     +Stress    -Stress
         ┌───────┐   ┌───────┐
         │Redup. │   │Redup. │
         │Stress │   │Stress Del.│
         │Del.   │   └───────┘
         └───────┘
        -Stress     -Stress
     ┌────────┐              ┌────────┐
     │Tone Del.│             │Tone Del.│
     └────────┘              └────────┘
        -Tone                  -Tone
   LEXICAL MODE          POST-LEXICAL MODE
```

FOOTNOTES

*This is a revised version of a paper presented
at the Workshop on Oriental Languages held in May
1985 at the University of Massachusetts/Amherst. I
wish to thank Lisa Selkirk for discussions I had with
her when preparing the paper. I am also grateful to
Paul Kiparsky, Tim Habick and two anonymous reviewers
for comments on the paper. I alone am responsible
for all errors and misconceptions. I would also
like to thank Emmon Bach for inviting me to the
Linguistics Department of the University of Massachu-
setts, where this paper was originally written.

[1]Putonghua (Common Speech) is the term used in
China today to refer to what has been termed Mandarin
in the literature in the West.

[2]The pinyin system is used in this paper to
transcribe Chinese characters.

[3]There is controversy in the literature on
whether the underlying form of Tone 3 is 21 or the
same as its citation form 214. We will not delve
into it in depth as it is only marginally relevant
to our discussion. For convenience sake we will use
the traditional symbol v to represent Tone 3 with
the understanding that except in citation form or
in prepausal positions Tone 3 has the pitch value
21 in all positions.

[4]At a lower level phonetic stage, we could
have the pitch value of the toneless element derived
by a set of ordered phonetic realization rules, such
as:

$$\emptyset \longrightarrow 4 \ / \ \text{Tone 3} \_\_\_$$
$$\emptyset \longrightarrow 1 \ / \ \text{Tone 4} \_\_\_$$
$$\emptyset \longrightarrow 3$$

or we could have it spread over from the tone of the
preceding syllable. However, I will not enter into
further discussion of the issue, as it is peripheral
to the content of the paper.

[5]There are different views on whether Tone 3
has changed to Tone 2 or to another tone (Tone 5) or
to an allotone of Tone 3. This has no direct bearing
to our discussion here and we assume that Tone 3
has changed to Tone 2 on the evidence of a perception
test carried out by Wang and Li (1967).
    Phoneticians have also talked about other cases
of tone sandhi in Chinese, such as Tone 1 sandhi
Tone 4 sandhi etc. We regard these changes as a

matter of phonetic realization rather than a question
of phonology. Take Tone 4 sandhi, for instance. When
one Tone 4 precedes another Tone 4, it changes its
pitch from 51 to 53. But as this change is gradient
and not categorical in nature (not involving any
feature change), we would formulate a low-level
phonetic implementation rule to indicate the change.

[6]In denoting stress, we use 1 to denote primary
stress, 2 to denote secondary stress and 0 to denote
no stress.

[7]The domain of the Post-Lexical Mode is the
phonological phrase, which could be a syntactic
compound, a phrase or a sentence. This is dependent
on syntactic configuration as well as on stylistic
factors such as degree of formality and speed of
speech.

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