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Prosodic Influences on Chinese Tongue Twisters·

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A diversity of structural alternations enriches tongue twisters, in form of a language game speakers consider intriguing while reciting. However, none of efforts are put into the interval between twister constituents. This study is an attempt to give a complimentary view to Chinese tongue twisters. The twister effects are actually affected both by unstable lexical structures and limited space between targeted constituents. Likewise, Optimality Theory (Prince and Smolensky 1993/2004) put forth a constraint-based account to these two issues.

1. Basics of tongue twisters

Tongue twisters are literary lines in which the twister readers are articulatorily stuck, especially at a fast speech rate. The intended speech errors come from those similar but distinct phonemes, such as *s* [s] and *sh* [ʃ] in the English example, or non-retroflex *s* [s] and retroflex *sh* [ʂ] in the Chinese case.

(1) English Tongue Twisters
Susan s[s]*ells sea*sh[ʃ] *ells by the sea*sh*ore.*
*Does she sell sea*sh*ells by the sea*sh*ore?*
*If she sells sea*sh*ells by the sea*sh*ore,*
*Where are the sea*sh*ells she sells by the sea*sh*ore?*

(2) Chinese Tongue Twisters
bu zhi shi s[s]*i sh*[ʂ]*i si zhi si shi-zi, hai shi si shi si zhi shi shi-zi*
'We don't know whether they are forty-four dead lions, or forty-four stone lions.'

In Chinese tongue twisters, couples of homophones amount to a twister effect. Double consonants, e.g. *tang* 'soup'/*ta* 'tower', or duplicated rhymes, e.g. *shi* 'ten'/*si* 'four' leave our tongue twistered. In that event, Chinese tongue twisters are known as *áo yǔ* 'language of twisters', *jí kǒu lìng* 'rhymes for fast reading', and *jīe kǒu rào* 'serial reading'.

· I am greatly indebted to Prof. San Duanmu and Prof. Yen-Hwei Lin for their valuable suggestions. The present work requires more efforts in feature theory, including the feature classification of targeted twisters. Also, the production experiment is expected with a detailed plan. All of the tasks are undertaken and the results will be shown in the future study.

This research furthers Yip (2001)'s self-compounding model in that twister constituents result from the recursive reduplication. In other words, the Chinese homophones, as in (2), are non-harmonically base-generated reduplicants. This research sets out for two goals. First, what are the types of the Chinese tongue twister effects? Second, what is the timing size triggering/blocking the twister effect?

This paper contains four parts. §1 presents the basics of Chinese tongue twisters, along with the goals of this research. §2 describes the types of Chinese twister effects with a review of reduplication issues, particularly Yip's (2000) self-compounding model. Also, this section proposes a constraint-based approach (Prince and Smolensky 1993, 2004) to account for twister effects. §3 looks into the diverse articulatory difficulty in terms of the prosodic interval, followed by an Optimality-theoretic account. §4 concludes this study.

2. Chinese tongue twister effects

2.1. Twister effects

This research collects data from two books. One is 'Chinese tongus twister dialogues' (Wei et al 1924); the other is 'Everybody plays with tongue twisters' (Yan 2000). 226 twister passages in total are under examination.

The twister effect shows a diversity of changes from homophones to words with an alternative tone, or in a reverse order. (3) and (4) exhibits typical examples of homophones. *si* 'four'/*shi* 'ten' in (3) and *tang* 'soup'/*ta* 'tower' in (4) form twister pairs respectively with different onsets and rhymes

(3) Onset Change
bu ***zhi*** ***shi*** ***si*** ***shi*** ***si*** ***zhi*** ***si*** ***shi-zi***, *hai* ***shi*** ***si*** ***shi*** ***si*** ***zhi*** ***shi*** ***shi-zi***
'We don't know whether they are forty-four dead lions, or forty-four stone lions.'

(4) Rhyme Change
he-shang duan ***tang*** *shang* ***ta***
'The monk takes soup, going up to the tower.'

ta *hua* ***tang*** *sa* ***tang*** ***tang*** ***ta***
'The tower is slippery, the soup spills out, and the soup burns the tower.'

On top of homophones, Chinese lexemes display different semantic meanings by changing its lexical tone and its word order. In (7) *zhuan*^{55} 'brick' and *zhuan*^{213} 'turn' in a sequence leads to the articulation difficulty. In (8) *niao* 'bird' and *dao-diao* 'hang down' are assigned alternative thematic roles in two clauses. Speakers feel confused while reading a passage in the reversed word order.

(5) Tonal Change

chang chong wei zhe ***zhuan^{55}*** *tui* ***zhuan^{213}****,* ***zhuan^{213}*** *wan le* ***zhuan^{55}*** *dui* ***zuan^{55}*** ***zhuan^{55}*** *dui.*

'Long worms surround piles of bricks and push turning. After moving around the brick piles, they bored those brick piles.'

(6) Linearity

liang shang liang dui ***dao-diao$_{(i)}$*** ***niao$_{(j)}$****; ni li liang* ***niao$_{(j)}$*** ***dao-diao$_{(i)}$***

'At the top of beams are two pairs of birds who are hanging down. In the mud hang two pairs of birds.'

2.2. Twister constituents as nonharmonic reduplicants

In order to account for the diverse twister effects, we posit twister pairs are borne out through reduplication. Reduplication has been widely discussed from perspectives like Prosodic Morphology Hypothesis (McCarthy and Prince 1986, 1996), template constraints (McCarthy and Prince 1993a, b; Kager 1999; Downing 2000; Gouskova 2007), and generalized constraints (Hendrick 2001; Crowhurst 2004). Many sustainable contributions (Chiang 1992, Ou 1996, Yip 2001, among others) go to cases of reduplication and triplication in Chinese dialects, especially from a view of prosodic morphology. This study proceeds along the synchronic thinking that the word formation comes partly from reduplication. Consider (7):

(7) Chaoyang and Fuzhou Dialect

/hop/	Rankings
Pattern 1 hop hop	Alliterate, Rhyme >> Markedness
Pattern 2 hop lop (+ suffix)	Rhyme >> Markedness >> Alliterate
Pattern 3 hi hop (kio)	Alliterate >> Markedness >> Rhyme
Pattern 4 hi hop lop (kio)	Alliterate, Rhyme >> Markedness
Pattern 5 həp lop	Markedness >> Rhyme

Alliterate and Rhymes are two constraints partially faithful to the input. In Chaoyang and Fuzhou dialect, five patterns of lexemes are attested by ranking Alliterate, Rhyme and Markedness constraints. Yip's (2001) self-compounding model underlines this idea.

(8) Self-compounding Model (Yip 2001)

One input can simultaneously yield more than one put. The IO-faithfulness relations are maintained with respect to such constraints as Alliterate and Rhyme. In Chinese tongue twisters we also find many similar cases. Under the framework of Optimality Theory (Prince & Smolensky 1993/2004), we successfully predict many twister types.

2.3. The optimality-theoretic account to twister effect

The interesting part of Chinese tongue twisters lies in the consecutive similar lexical pairs. The constraint (9) is posited to model these observed twister constituents. It is prohibited to see two identical constituents without any changes. Besides, Chinese is an isolation language. That is, a great number of morphemes can stand alone. Very few of Chinese morphemes are in adjunction to another morpheme. For instance, the diminutive ending *zi* with neutral tone is meaningless. Only when attached to other morphemes can it surface, e.g. *yizi* 'chair,' *zhuozi* 'table.' Therefore, the constraint F-Anchor is proposed.

(9) DistinctBase: A R-word that is segmentally identical to its base is ungrammatical.

(10) F-Anchor: The bound morpheme must be reduplicated without any internal change.

In §2.2. four types of twister effects have been shown. The constraints (11)-(13) are used to describe these four effects. In what follows are the analysis of these twister effects in OT tableaux.

(11) Alliterate: The input-output onset must be identical.
(12) Rhyme: The input-output rhyme must be identical.
(13) Linearity: The precedence structure of the input is the same in the output, and vice versa.
(14) Indent-T: The tonal categories of inputs must be identical to those of the output.

Language typology is predicted by ranking some of the universal constraints. When Alliterate is demoted, the candidate with onset change is selected. See (15).

(15) *shou-yi xue bu* ***hui*** *(51) (B)*
'Not learn well the handcraft.'

cai-liao-er yong de ***fei*** *(51) (R)*
'The material in need will be much.'

/hui51/	F-ANCHOR	DISTINCT BASE	RHYME	LINEARITY	IDENT-T	ALLITERATE
☞ a. fei51						*
b. hui51		*!				
c. hui35					*!	
d. hao51			*!			

The second effect is rhyme changes. When rhyme is ranked lower than the other three faithfulness constraints, the candidate (16b) is chosen.

(16) *ma-po mai* ***ma*** *(35)* ***-hua*** *(B)*
'The grandma with rough face bought fried dough twisters.'

dai-po ao ***mei*** *(35)* ***-hua*** *(R)*
'The grandma who looks stupid bought plum blossom.'

/ma35 hua55/	F-ANCHOR	DISTINCT BASE	ALLITERATE	LINEARITY	INDENT-T	RHYME
a. ma35 hua55		*!				
☞ b. mei35 hua55						*
c. fa35 hua55			*!			
d. ma21 hua55					*!	
e. hua55 ma35				*!		
f. rong35 shu51			*(!)*			**

On the other hand, the tonal change is also attested in my data, when Ident-T is ranked at the bottom, as in (17). Likewise, in (18) when Linearity is outranked by all, the twister effect with a reversed word order is chosen.

(17) **gui$_{(21)\,(B)}$** yao **gui$_{(55)\,(R)}$** pei gui de shui
'The ghost asked the turtle to compensate for its water.'

/gui21/	F-ANCHOR	DISTINCT BASE	ALLITERATE	RHYME	LINEARITY	INDENT-T
a. gui21		*!				
☞ b. gui55						*
c. shui21			*!			
d. guo21				*!		

(18) **ling35$_1$ long35$_2$ ta21$_3$ (B)**
'An exquisite tower'

ta21$_3$ ling35$_1$ long35$_2$ (R)
'The tower is exquisite'

/ling35$_1$ long35$_2$ ta21$_3$/	F-ANCHOR	DISTINCT BASE	ALLITERATE	RHYME	INDENT-T	LINEARITY
a. ling35$_1$ long35$_2$ ta21$_3$		*!				
☞ b. ta21$_3$ ling35$_1$ long35$_2$						*
c. ling35$_1$ hong35$_2$ ta21$_3$			*!			
d. ling35$_1$ long35$_2$ tie21$_3$				*!		
e. ling51$_1$ long35$_2$ ta21$_3$					*!	

3. Prosodic influences on twister effects

3.1. Lapse

The lexical structures are not a main cause to explain twister effects. Actually, the twister effects are prosodically constrained. Consider (19)-(20) for example.

(19) 'The tower is slippery, the soup spills out, and the soup burns the tower.'

ta	*hua*	*tang*	*sa*	*tang*	*tang*	*ta*
tower	slippery	soup	spill	soup	soup	tower

(20) 'The eggplants are placed on that plate.'
die-zi li cheng zhe qie-zi
plate inside fill PROG eggplant

The twister morphemes (underlined ones) in (19) are adjacent or spaced with one syllable, while those in (20) are taken apart by three syllables. While much emphasis is on the relation between total reduplication and its semantic link, few doubts are cast towards adjacency. In Chinese tongue twisters, a reduplicant may not be adjacent to its base. One twister constituent can be spaced with another constituent by one, two or even more syllables. This study gains greater interest in the prosodic domain between these fully/partially reduplicated constituents in Chinese tongue twisters. Before we solve the question on the prosodic domain between twister pairs, we first look at some empirical cases.

(21) s**o**m**e** sh**u**n s**u**n sh**i**n**e**
A 1 B 2 A 2 B 2

(22) t**a** hua t**ang** sa t**ang** tang t**a**
A1 A2 A 2 A1

In (21) we have A-B-A-B pattern. The distance between A and B is one syllable. In Chinese example (22), we get 1-2-2-1 pattern. The distance between 1 and 2 is one syllable, too. This articulatory distance between twister constituents is thus defined as 'lapse.' The follow-up question is what size of lapse responsible for the frustrated articulator.

3.2. Two-level twister effects

Schourup (1973) noted that the twister relationships within the metrical foot are quite important with respect to defining a tongue twister. In the present study, the twister tokens are parsed with the lapse of fewer than two syllables. The constraint MaxLapse=Ft is proposed to regulate the twister lapse smaller than one foot.

(23) MaxLapse=Ft: The twister lapse should not exceed one foot.

However, when MaxLapse=Ft is respected, some cases may run a risk of violating DistinctBase. Consider (26):

(24)[?] 'The tower is slippery, the soup spills out, and the soup burns the tower.' (=22)
ta hua tang sa tang tang ta
A1 A2 A2 A1

In (24) the second and the third constituent are parsed with one syllable interval in conformity of MaxLapse=Ft. Unfortunately, it incurs violations of MaxLapse=Ft with the identical words, i.e. A2-A2 pattern. But something different happens when the syntactic structure is carefully re-examined. The instance of (24) is reanalyzed into small IPs, as in (25).

(25) 'The tower is slippery, the soup spills out, and the soup burns the tower.'
[ta hua]$_{IP}$ # [tang sa]$_{IP}$ # [tang [tang ta]]$_{IP}$

IP is the domain within which twister effects work well. To put it simply, the speech is processed by IPs. There is a pause between any given two IPs. The pairs in violation of DistinctBase are protected by an IP bound. The speakers feel better when they encounter a short break. The articulation difficulties thus rarely occur across IPs.

Furthermore, as many psycholinguists observe, twisters reflect a difficulty in speech planning. According to Kupin (1982), tongue Twisters *do not* literally twist the articulators. What we are confused with is sequential patterns, like A, B, and 1, 2. Their recurring pattern is always aperiodic. In both of his and the present production experiment, lowing speech rate and reducing difficult phonetic features do not help decrease the error rates. In (24) pattern 1-2 followed by pattern 2-1 randomly shows up, forming a difficulty in speech planning.

To summarize, Chinese tongue twisters show *faithfulness* to morphosyntactic alignment while show *minimal unfaithfulness* to segments and suprasegments. (cf. Steriade's (2008) P-Map)

(26) 'A plate is on the palm.'
[*shou li* [*tuo zhe die-zi*]]

'The eggplants are placed on that plate.'
[*die-zi li* [*cheng zhe qie-zi*]]

In (26) *shou li* 'on the palm' and *die-zi li* 'on that plate' are structurally aligned, but lexically different. We thus posit another constraint, as in (27).

(27) Faith-BR (pos): The base and the R-word should be morphosyntactically aligned.

The present analysis shows there are two-level twister effects. One is within IP and the other is between IP. When twisters occur within IP, then MaxLapse=Ft is undominated. (28) illustrates this typical twister effect. Twister constituents must be different, and the lapse (time left for word processing) must be short. On the other hand, we have twister effect between IPs, as in (29). The bound between IPs can drive MaxLapse=Ft to the bottom. Faith-BR (pos) and the DistinctBase must be ranked high.

The restriction on speech processing is lengthened. Yet the morphosyntactic position must be aligned.

(28) Twister Lapse: Within IP
DistinctBase, MaxLapse=Ft » Faith-BR (pos)

(29) Twister Lapse: Between IPs
Faith-BR (pos), DistinctBase » MaxLapse=Ft

4. Concluding Remarks

The present study recapitulates the nature of Chinese tongue twister effects. This traditional Chinese game embodies a pile of issues to explore, like rhymes, complicated lexical structures, and so forth.

This paper pinpoints the twister effects are prosodically influenced. Four basic twister effects are attested with conflicting forces among constraints Alliterate, Rhyme, Linearity, Indent-T. However, many empirical experiments show that these complicated lexical structures do not increase the error rate. The prosodic influences play a crucial role. Twister effects are valid but need to be considered in two levels, within-IPs and between-IPs. Cophonologies are a way to resolve this complication.

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