The role of Strong Strong Start in Mandarin Tone 3 Sandhi

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1. Introduction

- **Match Theory** (Selkirk 2011): distinctness of prosodic and syntactic structures.
- **Match constraints**: the prosodic structure is isomorphic to the syntactic structure in the default case.

(1) a. **Match(XP, φ)**
The left and right edges of a lexical phrasal projection (XP) in the syntactic representation must correspond to the left and right edges of a phonological phrase (φ) in the phonological representation.

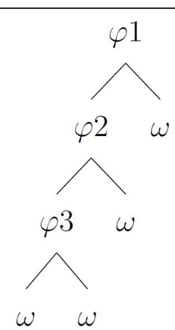
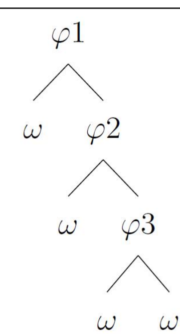
b. **Match(φ, XP)**
The left and right edges of a phonological phrase (φ) in the phonological representation must correspond to the left and right edges of a lexical phrasal projection (XP) in the syntactic representation.

- **Prosodic markedness constraints**: correspondence between the syntactic and prosodic structure can be altered on a language-particular basis.

- Selkirk's (2011) Strong Start constraint predicts a **left-/right-branching asymmetry**.

(2) **Strong Start**
A prosodic constituent optimally begins with a leftmost daughter constituent not lower in the prosodic hierarchy than **the constituent that immediately follows**.

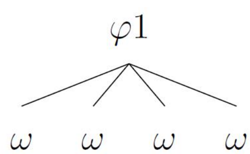
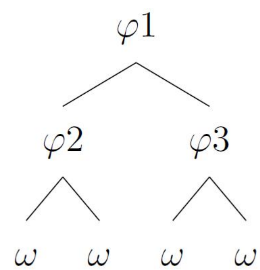
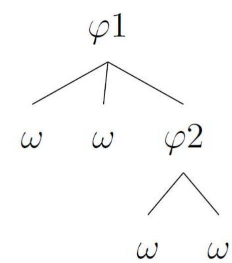
(3)

a. **Left**-branching structure: Strong Start is **satisfied**	b. **Right**-branching structure: Strong Start is **violated**
	

- Myrberg's (2013) EqualSisters constraint ...
  - ... predicts that an unbalanced, left- or right- branching syntactic structure will be "matched" by a balanced, flat or recursive prosodic structure.

(4) **EqualSisters**
Sister nodes in prosodic structure are instantiations of the same prosodic category.

(5)

a. **Balanced, flat** structure: EqualSisters is **satisfied**	b. **Balanced, recursive** structure: EqualSisters is **satisfied**	c. **Unbalanced** structure: EqualSisters is **violated**
		

- **Strong Start vs EqualSisters:**
  (i) Strong Start is asymmetrical, while EqualSisters is symmetrical.
  (ii) (5c) satisfies Strong Start, but violates EqualSisters.

- **This talk:** Mandarin (Chinese) Tone 3 Sandhi evidences a **more restrictive version of Strong Start**, which I refer to as Strong Strong Start:

(6) **Strong Strong Start**
A prosodic constituent optimally begins with a leftmost daughter constituent not lower in the prosodic hierarchy than **any sister constituent that follows**.

- Like Strong Start but unlike EqualSisters, **Strong Strong Start predicts a left-/right-branching asymmetry**.

- Unlike Strong Start but like EqualSisters, **Strong Strong Start is violated by (5c)**.

- **The effect of Strong Strong Start:** a right-branching syntactic constituent is "matched" by an equal-sisters prosodic constituent in the sense of Myrberg (2013), by
  (i) "flattening" the recursive structure (5a), or
  (ii) grouping syntactic non-sisters at the left edge (5b).

2. Tone 3 Sandhi: a domain-sensitive phenomenon

- **Tone 3 Sandhi (T3S)** ...
  - ... a phonological process by which a T3 (L) is changed to a sandhi tone (*s*) (LH) when it is followed by another T3 (L).[1]
  - ... a dissimilatory process where a H tone is inserted between two L tones (Yip 1980, 2002).

(7) T3S in Mandarin

L		LH			L
3	->	*s*	/	__	3

(8) 'good wine'

UR:	*hao*3	*jiu*3
	good	wine
SR:	*s*	3

- T3S is a **domain-sensitive phenomenon** ...
  - ... **three distinct patterns of realization** when more than two successive T3 syllables occur.

- In **grammatically unstructured strings** of numbers such as *wu*3 'five' ...
  - ... strings of four or more *wu*3 'five' are grouped into "Minimal Rhythm Units" (MRUs) that consist of two or three *wu*3 'five' (Chen 2000).
  - (9b): **rhythmic grouping**

(9)

Underlying representation	Surface representation
a. *wu*3 *wu*3 *wu*3 'five five five'	(*s s* 3)
b. *wu*3 *wu*3 *wu*3 *wu*3 'five five five five'	**(*s* 3) (*s* 3)**
c. *wu*3 *wu*3 *wu*3 *wu*3 *wu*3 'five five five five five'	(*s* 3) (*s s* 3)

[1] T3 has three variants (Chao 1968): it is LLH (dipping tone) in citation form and pre-pausally, LH (sandhi tone) before another T3, and L elsewhere. I assume, following Yip (1980, 2002) a.o., that a T3 is underlyingly L.

- **A left-branching structure** only has a *non-alternating T3S pattern*.
  - (11a): the rhythmic grouping seen in (9b) is not possible with a left-branching structure.

(10) ‘leave a bit earlier’

	UR:	[$_{VP}$	[$_{AP}$	*zao*3	*dian*3]	*zou*3]	
				early	a bit	leave	
a.	SR:			*3	*s*	3	
b.	SR:			*s*	*s*	3	

(11) ‘It is good to leave a bit earlier.’

	UR:	[$_{IP}$	[$_{VP}$	[$_{AP}$	*zao*3	*dian*3]	*zou*3]	*hao*3]
					early	a bit	leave	good
a.	**SR:**				***s***	**3**	***s***	**3**
b.	SR:				*3	*s*	*s*	3
c.	SR:				*s*	*s*	*s*	3

- The pattern of realization of **a right-branching structure** is more variable.
  - (12a) and (13a): *alternating T3S pattern*.

(12) ‘buy good wine’

	UR:	[$_{VP}$	*mai*3	[$_{NP}$	*hao*3	*jiu*3]]	
			buy		good	wine	
a.	SR:		3		*s*	3	(slow speech)
b.	SR:		*s*		*s*	3	(fast speech)

(13) ‘want to buy good wine’

	UR:	[$_{VP1}$	*xiang*3	[$_{VP2}$ *mai*3		[$_{NP}$	*hao*3	*jiu*3]]]
			want	buy			good	wine
a.	SR:		*s*	3			*s*	3
b.	SR:		3	*s*			*s*	3
c.	SR:		*s*	*s*			*s*	3

- **T3S applies cyclically bottom-up** on the syntactic structure (C. C. Cheng 1970, 1973, a.o.):
  - A left-branching structure has a non-alternating T3S pattern;
  - A right-branching structure has an alternating T3S pattern.
  - The various possibilities for a right-branching structure can be derived when the initial cycle coincides with a larger syntactic constituent.

- **T3S applies on a prosodic structure** (Shih 1986, 1997; Chen 1991, 2000; a.o.):
  - (14d): syntactic non-sisters can form a sandhi domain.

(14) ‘want to buy a good book’

	UR:	[$_{\text{VP1}}$ *xiang*3	[$_{\text{VP2}}$ *mai*3	[$_{\text{NP}}$ *hao*3	*shu*1]]]
		want	buy	good	book
a.	SR:	*3	3	3	1
b.	SR:	3	*s*	3	1
c.	SR:	*s*	*s*	3	1
d.	**SR:**	**(*s***	**3)**	**(3**	**1)**

3. A Match-Theory analysis

- **Proposal**: T3S applies cyclically bottom-up on a prosodic structure ...
  - ... “matched” from the syntactic structure of an expression, along the lines of the Match Theory of syntactic-prosodic constituency correspondence (Selkirk 2011).

- The left-/right-branching asymmetry lends support to the Match Theory.
  - Because left- and right-branching structures show distinct T3S patterns compared to grammatically unstructured strings ...
  - ... **both the right edge** of a left-branching structure **and the left edge** of a right-branching structure **must be detectable in the phonology.**

- The grammatical analogue of speech rate: **Strong Strong Start is ranked variably with respect to the Match constraints.**

(15) a. Match(XP, φ), Match(φ, XP) >> Strong Strong Start (slow speech)
b. Match(XP, φ), Match(φ, XP), Strong Strong Start
c. Strong Strong Start >> Match(XP, φ), Match(φ, XP) (fast speech)

- Assumption: the top node of the prosodic structure of an expression is an intonational phrase (ι) and the terminal nodes are prosodic words (ω).

(16) ‘buy good wine’

	UR:		[$_{\text{VP}}$ *mai*3	[$_{\text{NP}}$ *hao*3	*jiu*3]]	
			buy	good	wine	
a.	SR:	(ι	(φ_1 3	(φ_2 *s*	3)))	(slow speech)

Match(XP, φ)	Match(φ, XP)	Strong Strong Start
		φ_1

b.	SR:	(ι	(φ_1 *s*	*s*	3))	(fast speech)

Strong Strong Start	Match(XP, φ)	Match(φ, XP)
	NP	

- **The various possibilities for a right-branching structure** ...
  - ... follows from constraint interaction (17).
  - Candidate (a): the prosodic structure is isomorphic to the syntactic structure.
  - Candidates (b), (c), (d): a right-branching syntactic structure is "matched" by a (partially) balanced, flat prosodic structure.
  - Candidate (e): a right-branching syntactic structure is "matched" by a balanced, recursive prosodic structure.[2]

(17) 'want to buy good wine'

UR: [$_{VP1}$ *xiang*3 [$_{VP2}$ *mai*3 [$_{NP}$ *hao*3 *jiu*3]]]
want buy good wine

a. SR: (ι (φ$_1$ *s* (φ$_2$ 3 (φ$_3$ *s* 3))))

MATCH(XP, φ)	MATCH(φ, XP)	STRONG STRONG START	STRONG START	EQUALSISTERS
		φ$_1$, φ$_2$	φ$_1$, φ$_2$	φ$_1$, φ$_2$

b. SR: (ι (φ$_1$ 3 (φ$_2$ *s* *s* 3)))

MATCH(XP, φ)	MATCH(φ, XP)	STRONG STRONG START	STRONG START	EQUALSISTERS
NP		φ$_1$	φ$_1$	φ$_1$

c. SR: (ι (φ$_1$ *s* 3 (φ$_2$ *s* 3)))

MATCH(XP, φ)	MATCH(φ, XP)	**STRONG STRONG START**	**STRONG START**	EQUALSISTERS
VP2		**φ$_1$**		φ$_1$

d. SR: (ι (φ *s* *s* *s* 3))

STRONG START	EQUALSISTERS	STRONG STRONG START	MATCH(XP, φ)	MATCH(φ, XP)
			VP2, NP	

e. SR: (ι (φ$_1$ (φ$_2$ *s* 3) (φ$_3$ *s* 3)))

STRONG START	EQUALSISTERS	STRONG STRONG START	MATCH(XP, φ)	MATCH(φ, XP)
			VP2	φ$_2$

- **Not STRONG START:** prefers candidate (c) over candidates (b), (d), and (e).
- **Not EQUALSISTERS:** predicts various possibilities for a left-branching structure.

- **The lack of variation for a left-branching structure** ...
  - ... follows from the fact that its prosodic structure satisfies both the Match constraints and STRONG STRONG START in the default case; thus **any alteration is less optimal**.

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[2] One might speculate that candidate (d) is preferred over candidate (e) with MATCH(φ, XP) >> MATCH(XP, φ), while candidate (e) is preferred over candidate (d) with MATCH(XP, φ) >> MATCH(φ, XP).

(18) ‘It is good to leave a bit earlier.’

	UR:	[$_{IP}$	[$_{VP}$	[$_{AP}$ *zao*3	*dian*3]	*zou*3]	*hao*3]
				early	a bit	leave	good
a.	SR:			**s*	3	*s*	3
b.	SR:			*3	*s*	*s*	3
c.	SR:	(ι	(φ_1	(φ_2 *s*	*s*)	*s*)	3)

Match(XP, φ)	Match(φ, XP)	Strong Strong Start

Match(XP, φ)	Match(φ, XP)	Strong Strong Start

Strong Strong Start	Match(XP, φ)	Match(φ, XP)

- **Size constraints**: constraints that require a prosodic constituent to be binary (Elfner 2012, 2015).

(19) a. **BinMin(κ)**
A prosodic constituent of type κ must immediately dominate **at least two** daughter constituents in the output phonological representation.

b. **BinMax(κ)**
A prosodic constituent of type κ must immediately dominate **at most two** daughter constituents in the output phonological representation.

- In Mandarin, BinMin(φ) is top-ranked.
  - **BinMin(φ) >> Strong Strong Start**: a ω cannot be promoted to a φ.
  - **BinMin(φ) >> Match**: a single-word XP is not “matched” by a φ.

(20) ‘buy good book’

	UR:		[$_{VP1}$	***mai*3**	[$_{NP}$ *hao*3	*shu*1]]
				buy	good	book
a.	SR:	(ι	(φ_1	*s*	(φ_2 3	1)))
b.	SR:	(ι	(φ_1	*s*	3	1))

BinMin(φ, ω)	Strong Strong Start	Match(XP, φ)	Match(φ, XP)
		NP	

c. SR: *(ι (φ_1 **(φ_2 3)** (φ_3 3 1)))

BinMin(φ, ω)	Strong Strong Start	Match(XP, φ)	Match(φ, XP)
φ_2			φ_2

(21) ‘Horses roar.’

UR: [$_{IP}$ **[$_{NP}$ *ma*3]** **[$_{VP}$ *hou*3]**]

horse roar

a. SR: *(ι **(φ$_1$ 3)** **(φ$_2$ 3)**)

BinMin(φ, ω)	Match(XP, φ)	Match(φ, XP)	Strong Strong Start
φ$_1$, φ$_2$			

b. SR: (ι *s* 3)

BinMin(φ, ω)	Strong Strong Start	Match(XP, φ)	Match(φ, XP)
		NP, VP	

- **BinMax** is absent at the phonological phrase level but **present at the foot level** ...
  - ... which accounts for the rhythmic grouping in grammatically unstructured strings.

(22)

Underlying representation	Surface representation
a. *wu*3 *wu*3 *wu*3 ‘five five five’	(*s s* 3)
b. *wu*3 *wu*3 *wu*3 *wu*3 ‘five five five five’	**(*s* 3) (*s* 3)**
c. *wu*3 *wu*3 *wu*3 *wu*3 *wu*3 ‘five five five five five’	**(*s* 3) (*s s* 3)**

- Chen (2000) takes (23d) to evidence that correspondence between syntactic and prosodic structure can be overridden in virtue of **a preference for the rhythmic grouping seen in (22b)**.

(23) ‘want to buy a good book’

UR: [$_{VP1}$ *xiang*3 [$_{VP2}$ *mai*3 [$_{NP}$ *hao*3 *shu*1]]]

want buy good book

a. SR: *3 3 3 1

b. SR: 3 *s* 3 1

c. SR: *s* *s* 3 1

d. SR: (*s* 3) (3 1)

- **Two obvious problems:**

(i) The rhythmic grouping is not possible with a left-branching structure.

(ii) The rhythmic grouping is not possible with a mixed-branching structure such as (24).[3]

[3] To confront this problem, Chen (2000) has to stipulate that terminal nodes that are sisters in the syntactic structure must be sisters in the prosodic structure.

(24) ‘want to leave a bit earlier’

UR: [$_{VP1}$ *xiang*3 [$_{VP2}$ [$_{AP}$ *zao*3 *dian*3] *zou*3]]]

want early a bit leave

a. SR: (ι (φ1 3 (φ2 (φ3 *s* *s*) 3)))

MATCH(XP, φ)	MATCH(φ, XP)	STRONG STRONG START
		φ1

b. SR: (ι (φ1 *s* *s* *s* 3))

STRONG STRONG START	MATCH(XP, φ)	MATCH(φ, XP)
	VP2, AP	

c. SR: *(ι (φ1 (φ2 *s* *s*) (φ3 *s* 3)))

STRONG STRONG START	MATCH(XP, φ)	**MATCH(φ, XP)**
	VP2, AP	**φ2, φ3**

4. Asymmetrical EQUALSISTERS?

- The Match Theory is a retreat from Selkirk’s (1986) Align-XP model.
  - Align-XP: in the default case **only one edge** of a syntactic constituent aligns with a prosodic boundary.

(25) a. **ALIGN-L(XP, φ)**
The left edge of a lexical phrasal projection (XP) in the syntactic representation must correspond to the left edge of a phonological phrase (φ) in the phonological representation.

b. **ALIGN-R(XP, φ)**
The right edge of a lexical phrasal projection (XP) in the syntactic representation must correspond to the right edge of a phonological phrase (φ) in the phonological representation.

c. **ALIGN-L(φ, XP)**
The left edge of a phonological phrase (φ) in the phonological representation must correspond to the left edge of a lexical phrasal projection (XP) in the syntactic representation.

d. **ALIGN-R(XP, φ)**
The right edge of a phonological phrase (φ) in the phonological representation must correspond to the right edge of a lexical phrasal projection (XP) in the syntactic representation.

- **Alternative analysis:** the left-/right-branching asymmetry indicates ...
  - ... the right edge (of a left-branching structure) always aligns with a prosodic boundary;
  - ... alignment of the left edge (of a right-branching structure) and a prosodic boundary can be overridden in virtue of other prosodic considerations.
  - **Proposal:** Align-R(XP, φ) is top-ranked; EqualSisters is ranked variably with respect to Align-L(XP, φ).

- **The various possibilities for a right-branching structure** ...
  - ... follows from constraint interaction (26) (cf. 17).
  - Candidate (a): the prosodic structure is isomorphic to the syntactic structure.
  - Candidates (b), (c), (d): a right-branching syntactic structure is "matched" by a (partially) balanced, flat prosodic structure.
  - Candidate (e): a right-branching syntactic structure is "matched" by a balanced, recursive prosodic structure.[4]

(26) 'want to buy good wine'

UR: $[_{VP1}$ *xiang*3 $[_{VP2}$ *mai*3 $[_{NP}$ *hao*3 *jiu*3**]]]**
want buy good wine

a. SR: (ι (φ_1 *s* (φ_2 3 (φ_3 *s* 3))))

Align-R(XP, φ)	Align-L(XP, φ)	EqualSisters	Align-R(φ, XP)
		φ_1, φ_2	

b. SR: (ι (φ_1 3 (φ_2 *s* *s* 3)))

Align-R(XP, φ)	Align-L(XP, φ)	EqualSisters	Align-R(φ, XP)
	NP	φ_1	

c. SR: (ι (φ_1 *s* 3 (φ_2 *s* 3)))

Align-R(XP, φ)	Align-L(XP, φ)	EqualSisters	Align-R(φ, XP)
	VP2	φ_1	

d. SR: (ι (φ *s* *s* *s* 3))

Align-R(XP, φ)	EqualSisters	Align-L(XP, φ)	Align-R(φ, XP)
		VP2, NP	

e. SR: (ι (φ_1 (φ_2 *s* 3) (φ_3 *s* 3)))

Align-R(XP, φ)	EqualSisters	Align-L(XP, φ)	Align-R(φ, XP)
		NP	φ_2

[4] One might speculate that candidate (d) is preferred over candidate (e) with Align-R(φ, XP) >> Align-L(XP, φ), while candidate (e) is preferred over candidate (d) with Align-L(XP, φ) >> Align-R(φ, XP).

- **The lack of variation for a left-branching structure** ...
  - ... follows from the fact that top-ranked Align-R(XP, φ) demands the prosodic structure to also be left-branching (cf. 18).

(27) 'It is good to leave a bit earlier.'

UR: $[_{IP}$ $[_{VP}$ $[_{AP}$ *zao*3 *dian*3**]** *zou*3**]** *hao*3**]**
early a bit leave good

a. SR: **s* 3 *s* 3
b. SR: *3 *s* *s* 3
c. SR: (ι $(\varphi_1$ $(\varphi_2$ *s* *s***)** *s***)** 3**)**

Align-R(XP, φ)	Align-L(XP, φ)	EqualSisters	Align-R(φ, XP)
		ι, φ_1	

- **Problem**: the non-alternating T3S pattern of (28) cannot be generated (cf. 24).

(28) 'want to leave a bit earlier'

UR: $[_{VP1}$ *xiang*3 $[_{VP2}$ $[_{AP}$ *zao*3 *dian*3**]** *zou*3**]]]**
want early a bit leave

a. SR: (ι $(\varphi_1$ 3 $(\varphi_2$ *s* *s***)** 3**)))**

Align-R(XP, φ)	Align-L(XP, φ)	EqualSisters	Align-R(φ, XP)
		φ_1	

b. SR: (ι $(\varphi_1$ *s* *s* *s* 3))

Align-R(XP, φ)	EqualSisters	Align-L(XP, φ)	Align-R(φ, XP)
AP		VP2, AP	

5. Conclusion

- I proposed a **Match-Theory analysis** of Mandarin T3S that captures a **left-/right-branching asymmetry**.
  - **Both the right edge** of a left-branching structure **and the left edge** of a right-branching structure are detectable in the phonology.

- Mandarin T3S evidences a **more restrictive version of Strong Start**, which I refer to as Strong Strong Start.

- **The effect of Strong Strong Start:** a right-branching syntactic constituent is "matched" by an equal-sisters prosodic constituent in the sense of Myrberg (2013), by
  (i) "flattening" the recursive structure, or
  (ii) grouping syntactic non-sisters at the left edge.

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