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Tone Sandhi in Comaltepec Chinantec

- Comaltepec Chinantec tone sandhi is almost always allophonic; rarely neutralizing
- Sandhi influenced by concrete physical forces and abstract functional forces
- The formal-functional dichotomy is a false one

(1)   Comaltepec Chinantec lexical tone inventory (Anderson 1989, Anderson, Martinez, and Pace 1990, Pace 1990):
L, **M**, **H**, **LM**, **LH**

(2)   relevant phonotactics:
Vowel length is contrastive: **V, Vː**
h is contrastive post-vocalically: **Vh, Vːh**
Long open vowels cannot be **H**:   ***VːH**

(3)   tone sandhi:
Rightward spread of **H** tones from **LH** syllables
H-insertion following **Mː** syllables

(4)

triggers	targets	outputs	exemplification		
LH, Mː	**L(ː)**	**HL(ː)**	**Allophonic Sandhi Output**		
			L → *HL* / LH__		
			kwaᴸᴴ hiᴸ	→ kwaᴸᴴ hiᴴᴸ	give a book
			kwaᴸᴴ toːᴸ	→ kwaᴸᴴ toːᴴᴸ	give a banana
			kwaᴸᴴ ŋihᴸ	→ kwaᴸᴴ ŋihᴴᴸ	give a chayote
			L → *HL* / Mː__		
			miːᴹ hiᴸ	→ miːᴹ hiᴴᴸ	I ask for a book
			miːᴹ toːᴸ	→ miːᴹ toːᴴᴸ	I ask for a banana
			miː ᴹ ŋihᴸ	→ miːᴹ ŋihᴴᴸ	I ask for a chayote
LH, Mː	**Mː**	**HMː**	**Allophonic Sandhi Output**		
			M → *HM* / LH__		
			kwaᴸᴴ kuːᴹ	→ kwaᴸᴴ ku:ᴴᴹ	give money
			kwaᴸᴴ ⁿdʒuːᴹ	→ kwaᴸᴴ ⁿdʒuːᴴᴹ	give a jug
			kwaᴸᴴ ʔoːᴹ	→ kwaᴸᴴ ʔoːᴴᴹ	give papaya
			M → *HM* / Mː__		
			miːᴹ kuːᴹ	→ miːᴹ kuːᴴᴹ	I ask for money
			miːᴹ ⁿdʒuːᴹ	→ miːᴹ ⁿdʒuːᴴᴹ	I ask for a jug
			miːᴹ ʔoːᴹ	→ miːᴹ ʔoːᴴᴹ	I ask for papaya

LH, Mː	Mh	Hh	**Neutralizing Sandhi Output**		
			Mh → *H*h / LH__		
			kwa^{LH} tũh^{M}	→ kwa^{LH} tũh^{H}	give two
			kwa^{LH} ŋeːh^{M}	→ kwa^{LH} ŋeːh^{H}	give twenty
			kwa^{LH} kja?ʂ^{M}	→ kwa^{LH} kjah?ʂ^{H}	give his
			Mh → *H*h / Mː__		
			miːr^{M} tũh^{M}	→ miːr^{M} tũh^{H}	I ask for two
			miːr^{M} ŋeːh^{M}	→ miːr^{M} ŋeːh^{H}	I ask for twenty
			miːr^{M} kja?ʂ^{M}	→ miːr^{M} kja?ʂ^{H}	I ask for his
LH, Mː	H	H	**Vacuous Sandhi Output**		
			(H → H / LH__		
			H → H / Mː__)		
LH, Mː	LM(ː)	LM(ː)	**Sandhi Blocked**		
			(LM → LM / LH__		
			LM → LM / Mː__)		
LH, Mː	LH(ː)	MH(ː)	**Allophonic Sandhi Output**		
			LH → *MH* / LH __		
			kwa^{LH} ŋi^{LH}	→ kwa^{LH} ŋi^{MH}	give salt
			kwa^{LH} loh^{LH}	→ kwa^{LH} loh^{MH}	give a cactus
			kwa^{LH} kũh^{LH}	→ kwa^{LH} kũh^{MH}	give a stone
			LH → *MH* / Mː __		
			miːr^{M} ŋi^{LH}	→ miːr^{M} ŋĩ^{MH}	I ask for salt
			miːr^{M} loh^{LH}	→ miːr^{M} loh^{MH}	I ask for a cactus
			miːr^{M} kũh^{LH}	→ miːr^{M} kũh^{MH}	I ask for a stone

(5)   The Observations:
   a. **LM** is not a target
   b. **Mh** is the only neutralizing target (to **Hh**)
   c. only **LH** and **Mː** are triggers

(6)   The Question: What governs the patterning of tone sandhi?

(7)   The Proposal:
   (1) **Physical** systems--*aerodynamic*, *articulatory*, *acoustic*--in conjunction with
   (2) The abstract **functional** principles of *contrast maintenance*, *conservation of effort*, and *pattern coherence*, and
   (3) **historical forces** rooted in (1) and (2), all bear a direct influence on phonological patterning, and may influence tone spreading.

(8)   <u>Hyman and Schuh 1974</u>:
(a) spreading/displacement is far more often rightward than leftward
(b) spreading/displacement is far more likely to take place when the pitch interval
between   the two tones is relatively great

(9)   **Physical** forces affecting **LH** sandhi triggers:

a.   Pitch rises are accomplished much more slowly than pitch falls (Ohala and Ewan 1973,
Sundberg 1973)
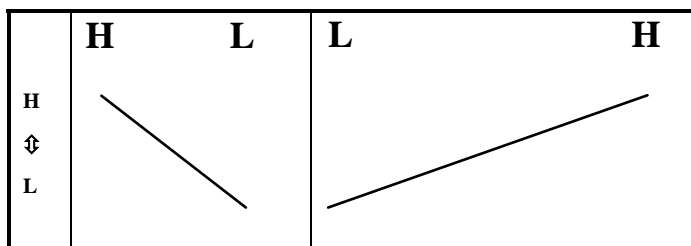
b.   **H** tones in **LH** contours are consequently much more likely to "spill over" on to a
following vowel (Ohala 1978)
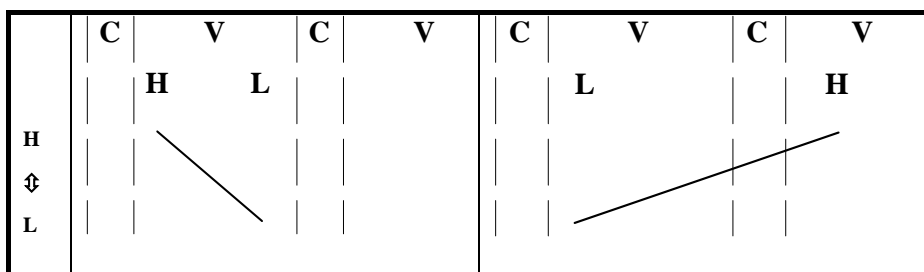
(10)   <u>Articulatory Phonology (Browman and Goldstein 1986, 1989, 1990, 1991, 1992, 1995)</u>:
Phonological primitives consist of temporally arranged (or "phased") gestures.
Gestural notation employed herein:

■ = optimally recoverable
▦ = sub-optimally recoverable
▩ = unrecoverable

(11)   a.   **H** to **L**:   b.   **L** to **H**:
H-tone: H-tone:
⇕   ⇕
L-tone: L-tone:
                  H   L   **L   H**

3

(12)   a.   **H** to **L**:   b.   **L** to **H**:

S(upra)L(aryngeal):   coronal stop: coronal stop:

low vowel: low vowel:

L(aryngeal):   H tone: H tone:

L tone: L tone:

a^H   L   t   a^L   H   t

(13)   sandhi patterns:

Allophonic Sandhi Output

a.   **L → *HL* / LH ___**

input: output:

SL: coronal stop: coronal stop:

low vowel: low vowel:

L: H-tone: H-tone:

L-tone: L-tone:

a^L   H   t   a^L   a^L   H   t   a^HL

Allophonic Sandhi Output

b.   **M → *HM* / LH ___**

input: output:

SL: coronal stop: coronal stop:

low vowel: low vowel:

L: H-tone: H-tone:

M-tone: M-tone:

L-tone: L-tone:

a^L   H   t   a^M   a^L   H   t   a^HM

Neutralized Sandhi Output

c.   **Mh → *H*h / LH ___**

input: output:

SL: coronal stop: coronal stop:

low vowel: low vowel:

L: H-tone: H-tone:

M-tone: M-tone:

L-tone: L-tone:

abduction: abduction:

a^L   H   t   a^M   h   a^L   H   t   a^H   h

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Vacuous Sandhi Output

d. (H → H / LH ___)

input: output:

SL: coronal stop: coronal stop:
     low vowel: low vowel:
L: H-tone: H-tone:
     M-tone: M-tone:
     L-tone: L-tone:
            a^L H t a^H a^L H t a^H

Sandhi Blocked

e. (LM → LM / LH ___)

input: output:

SL: coronal stop: coronal stop:
     low vowel: low vowel:
L: H-tone: H-tone:
     M-tone: M-tone:
     L-tone: L-tone:
            a^L H t a^{LM} a^L H t a^{LM}

Allophonic Sandhi Output

f. **LH → MH / LH ___**

input: attested **MH** (allophonic):

SL: coronal stop: coronal stop:
     low vowel: low vowel:
L: H-tone: H-tone:
     M-tone: M-tone:
     L-tone: L-tone:
            a^L H t a^L H a^L H t a^M H

(where ⬡ indicates the pre-blended value)

(14) **Functional** forces affecting **LH**-triggered sandhi: The function of a phonology is to render contrasts distinct (without excessive effort)

a. -Sandhi is **neutralizing** *only when the contrast is inherently weak*
    -**M** syllables which neutralize with **H** always possess contrastive post-vocalic aspiration
    -post-vocalic aspiration is accompanied by a moderate pitch rise in Comaltepec (Silverman 1995)

input:

SL: coronal stop:
low vowel:
L: H-tone:
M-tone:
L-tone:
abduction:

a^L　ᴴ　t　a$^{M(H)}$　h

unattested output:

coronal stop:
low vowel:
H-tone:
M-tone:
L-tone:
abduction:

a^L　ᴴ　t　a$^{H(MH)}$　h
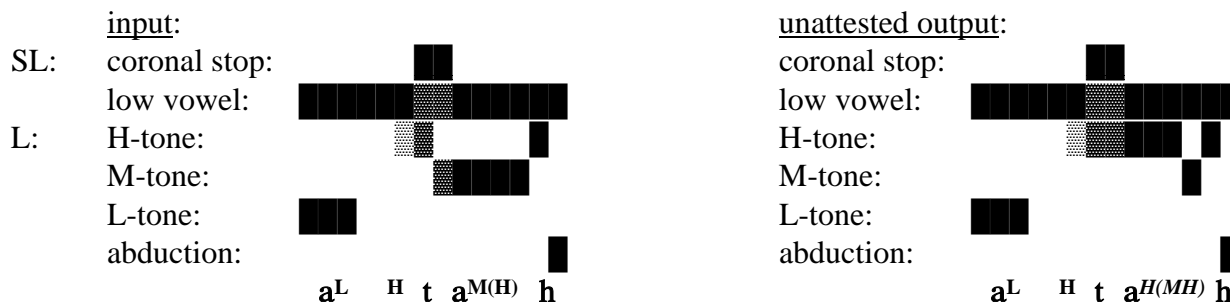
-<u>suggestion</u>: It's not worth exerting the articulatory effort to maintain the contrast in this environment, or, the effort does not have sufficient perceptual payoff to communicate the contrast

attested output:

SL: coronal stop:
low vowel:
L: H-tone:
M-tone:
L-tone:
abduction:

a^L　ᴴ　t　a^H　　h
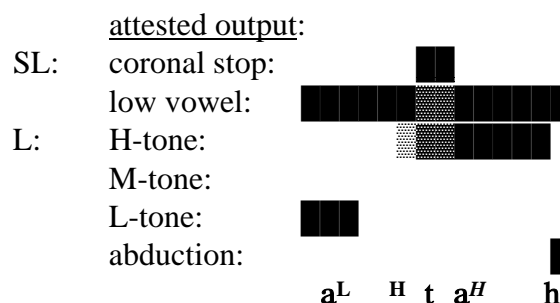
b.　　-Sandhi into **LM** domains would neutralize a robust contrast.

input:

SL: coronal stop:
low vowel:
L: H-tone:
M-tone:
L-tone:

a^L　ᴴ　t　a^{LM}

output:
unattested **HLM** (neutralized):

coronal stop:
low vowel:
H-tone:
M-tone:
L-tone:

a^L　ᴴ　t　a$^{H?L?M?}$

unattested **M** (neutralized):

SL: coronal stop:
low vowel:
L: H-tone:
M-tone:
L-tone:

a^L　ᴴ　t　a^M

(where ⟨▨⟩ indicates the pre-blended value)
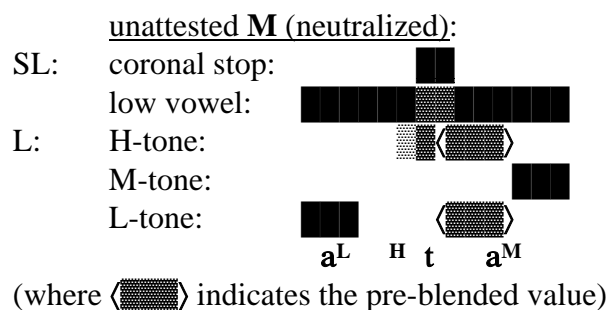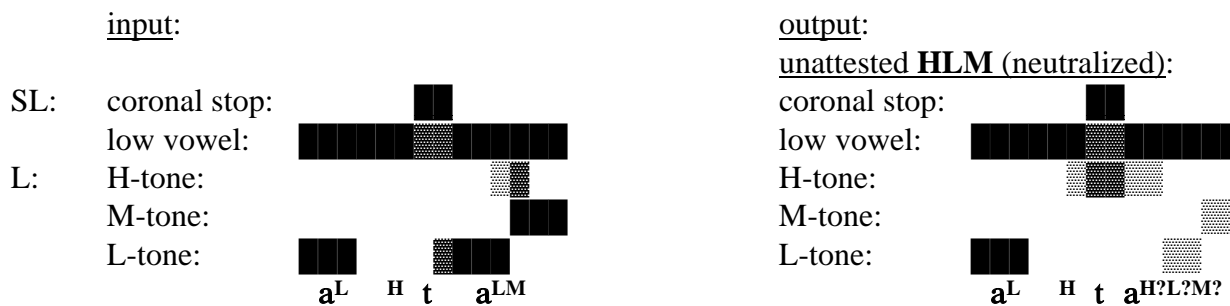
-Blocking sandhi here salvages this contrast, although the preceding **H** tone is not optimally implemented

attested output **LM** (sandhi blocked):
SL: coronal stop:
     low vowel:
L: H-tone:
     M-tone:
     L-tone:

a^L H t   a^{LM}
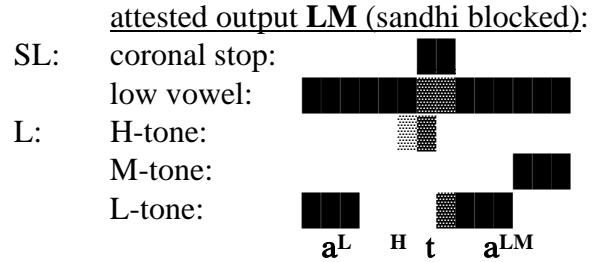
(15)   But whence **Mɪ**-triggered sandhi?

Mɪ triggers are historically derived from **Hɪ** (Rensch 1989):

present-day Comaltepec:	reconstructed Proto-Chinantec:	gloss:
ʔoːᴹ	*ʔãːʔᴴ	papaya
kuɪᴹ	*kuɪᴴ	money
ⁿdʒœɪᴹ	*dʒuɪᴴ	earthen jar/jug
ʔwɨːŋᴹ	*ʔwɨːᴴ	Ojitlán (a large Chinantec village)

(16)   Post-vocalic laryngeals in Comaltepec serve to moderately raise pitch (Silverman 1995). This may phonologize as a tonal distinction.

pitch range: historic **H**-tone with additional laryngeal gesture   present-day **H**-tone with additional laryngeal gesture

H
M
L
h/ʔ

H   **H**

pitch range: historic **H**-tone without additional laryngeal gestures: present-day **H**-tone without additional laryngeal gestures:

H
M
L

H   **M**

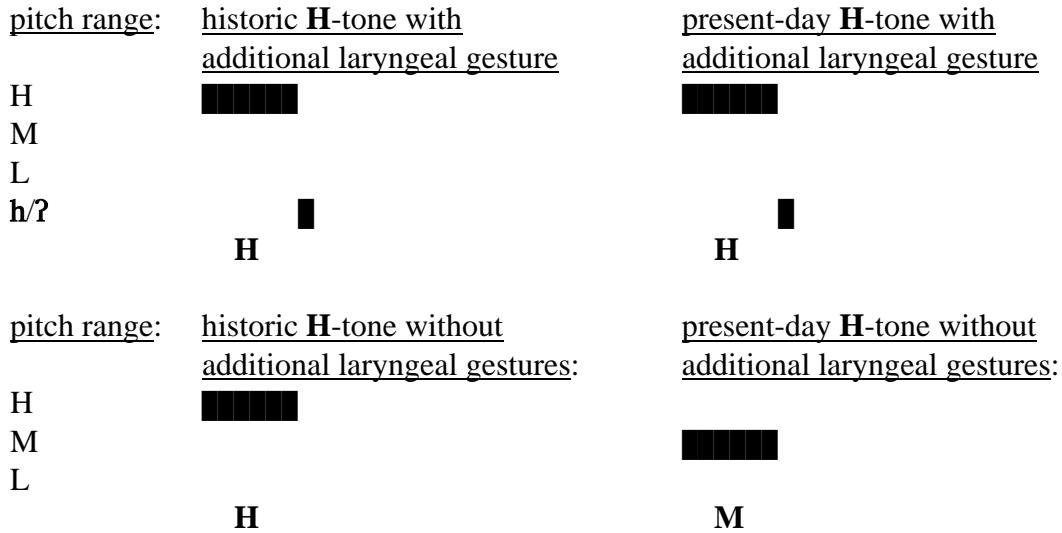(17)   Historic level **H**-tones lacking post-vocalic laryngeals may spread rightward *not* due to the forces of contrast maintenance, but due to natural assimilatory tendencies, i.e., *economy of effort*, in conjunction with *pattern coherence*.

(18)   <u>Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993):</u>
      -phonology may be viewed as a struggle between ease of perception and ease of production (Martinet 1952, Lindblom 1990)
      -Optimality Theory allows us to formally express this struggle as a series of ranked constraints

(19)   <u>constraint families</u>:

recover:

(no stars)	=	cue fully (optimally) recoverable
*	=	cue sub-optimally recoverable
**	=	cue not present; unrecoverable

economize:

(no stars)	=	gesture not implemented
*	=	gesture implemented

(20)   **<u>LH</u>** triggers:

<u>Allophonic Sandhi Output:</u>

1	**input:** $a^{LH}ta^{L}$	**recover**	**economize**
a ☞	$a^{LH}ta^{HL}$	lower pitch higher pitch lower pitch	*slack vocal folds *stiff vocal folds *slack vocal folds
b	$a^{LH}ta^{L}$	lower pitch ***!higher pitch** lower pitch	*slack vocal folds *stiff vocal folds *slack vocal folds
c	$a^{L}a^{L}$	lower pitch ***!*higher pitch** lower pitch	*slack vocal folds stiff vocal folds slack vocal folds

<u>Allophonic Sandhi Output:</u>

2	**input:** $a^{LH}ta^{M}$	**recover**	**economize**
a ☞	$a^{LH}ta^{HM}$	lower pitch higher pitch middle pitch	*slack vocal folds *stiff vocal folds *semi-slack vocal folds
b	$a^{LH}ta^{M}$	lower pitch ***!higher pitch** middle pitch	*slack vocal folds *stiff vocal folds *slack vocal folds
c	$a^{L}ta^{M}$	lower pitch ***!*higher pitch** middle pitch	*slack vocal folds stiff vocal folds *semi-slack vocal folds

Neutralizing Sandhi Output:

3	input: $a^{LH}tah^{M}$	economize: **neutralize M** **Mh → _H_h/LH.___**	recover	economize
a ☞	$a^{LH}tah^{H}$		lower pitch higher pitch **middle pitch	*slack vocal folds *stiff vocal folds semi-slack vocal folds
b	$a^{LH}tah^{HM}$	 ***!semi-slack vocal folds**	lower pitch higher pitch *middle pitch	*slack vocal folds *stiff vocal folds
c	$a^{LH}tah^{M}$	 ***!semi-slack vocal folds**	lower pitch *higher pitch middle pitch	*slack vocal folds *stiff vocal folds
d	$a^{L}tah^{M}$	 ***!semi-slack vocal folds**	lower pitch **higher pitch middle pitch	*slack vocal folds *stiff vocal folds

Vacuous Sandhi Output:

4	input: $a^{LH}ta^{H}$	recover	economize
a ☞	$a^{LH}ta^{H}$	lower pitch higher pitch	*slack vocal folds *stiff vocal folds

Sandhi Blocked:

5	input: $a^{LH}ta^{LM}$	recover	economize
a ☞	$a^{LH}ta^{LM}$	lower pitch *higher pitch lower pitch middle pitch	*slack vocal folds *stiff vocal folds *slack vocal folds *semi-slack vocal folds
b	$a^{LH}ta^{HLM}$	lower pitch *higher pitch ***!lower pitch** *middle pitch	*slack vocal folds *stiff vocal folds *slack vocal folds *semi-slack vocal folds
c	$a^{LH}ta^{M}$	lower pitch *higher pitch ***!*lower pitch** middle pitch	*slack vocal folds *stiff vocal folds slack vocal folds *semi-slack vocal folds
d	$a^{L}ta^{LM}$	lower pitch ***!*higher pitch** lower pitch middle pitch	*slack vocal folds stiff vocal folds slack vocal folds *semi-slack vocal folds

Allophonic Sandhi Output:

6	input: a^{LH}ta^{LH}	recover	economize
a ☞	a^{LH}ta^{MH}	lower pitch higher pitch middle (<hi/lo) pitch *higher pitch	*slack vocal folds *stiff vocal folds *semi-slack vocal folds *stiff vocal folds
b	a^{LH}ta^{LH}	lower pitch ***!higher pitch** lower pitch *higher pitch	*slack vocal folds *stiff vocal folds *slack vocal folds *stiff vocal folds
c	a^{LH}ta^{HLH}	lower pitch ***!higher pitch** **lower pitch *higher pitch	*slack vocal folds *stiff vocal folds *slack vocal folds *stiff vocal folds
d	a^Lta^{LH}	lower pitch ***!*higher pitch** lower pitch *higher pitch	*slack vocal folds stiff vocal folds slack vocal folds *stiff vocal folds

(21)   **LH** triggers lend themselves to an exclusively synchronic explanation; **Mː** triggers do not. In order to *explain* sandhi here, history *must* be considered relevant to the synchronic system. Rule ordering effectively models historical change.

(1)   **T**   →   **HT / Hː ___**
(2)   **Hː**   →   **Mː**

(3) <u>pattern coherence</u>: minimize allophony up to recoverability.

triggers:	targets:			discussion:
☑ LH	☑L	→	HL	sandhi motivated by contrast maintenence
	☑LH	→	MH	
	☑Mɪ	→	HMɪ	
	☑Mɦ	→	Hɦ	
	☑H	→	H	
	☒LM	→	LM	
☑ HØ	☑L	→	HL	sandhi motivated by pattern coherence
	☑LH	→	MH	
	☑Mɪ	→	HMɪ	
	☑Mɦ	→	Hɦ	
	☑H	→	H	
	☒LM	→	LM	
HØ → MØ				sound change motivated by aerodynamic forces
☑ MØ	☑L	→	HL	sandhi remains
	☑LH	→	MH	
	☑Mɪ	→	HMɪ	
	☑Mɦ	→	Hɦ	
	☑H	→	H	
	☒LM	→	LM	

(where Ø = no post-vocalic laryngeals)

(22)

Allophonic Sandhi Output:

1	input: aɪ^{M}ta^L	recover	economize
a ☞	*aɪ^{M}ta^L	middle pitch	*semi-slack vocal folds
		lower pitch	*slack vocal folds
b 👆	aɪ^{M}ta^{HL}	middle pitch	*semi-slack vocal folds
			*!stiff vocal folds
		lower pitch	*slack vocal folds

Allophonic Sandhi Output:

2	input: aɪ^{M}taɪ^M	recover	economize
a ☞	aɪ^{M}ta^M	middle pitch	*semi-slack vocal folds
		middle pitch	*semi-slack vocal folds
b 👆	aɪ^{M}ta^{HM}	middle pitch	*semi-slack vocal folds
		*!higher pitch	*stiff vocal folds
		middle pitch	*semi-slack vocal folds

Neutralizing Sandhi Output:

3	input: aɹ^Mtah^M	economize: neutralize M Mh → *H*h/Mɹ.___	recover	economize
a ☞	aɹ^Mtah^M		middle pitch middle pitch	*semi-slack vocal folds
b	aɹ^Mtah^{HM}	 ***!semi-slack vocal folds**	middle pitch middle pitch	*semi-slack vocal folds ***!stiff vocal folds** *semi-sleack vocal folds
c ☝	aɹ^Mtah^H	 ***!semi-slack vocal folds**	middle pitch ***!*middle pitch**	*semi-slack vocal folds *stiff vocal folds

Vacuous Sandhi Output:

4	input: aɹ^Mta^H	recover	economize
a ☞ ☝	aɹ^Mta^H	middle pitch higher pitch	*semi-slack vocal folds *stiff vocal folds

Sandhi Blocked:

5	input: aɹ^Mta^{LM}	recover	economize
a ☞ ☝	a^Mta^{LM}	middle pitch lower pitch middle pitch	*semi-slack vocal folds *slack vocal folds *semi-slack vocal folds
b	aɹ^Mta^{HLM}	middle pitch ***!lower pitch** *middle pitch	*semi-slack vocal folds *stiff vocal folds *slack vocal folds *semi-slack vocal folds
c	aɹ^Mta^M	middle pitch ***!*lower pitch** middle pitch	*semi-slack vocal folds

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Allophonic Sandhi Output:

6	input: aɾ^{M}ta^{LH}	recover	economize
a ☞	aɾ^{M}ta^{LH}	middle pitch lower pitch *higher pitch	*semi-slack vocal folds *slack vocal folds *stiff vocal folds
b 👍	aɾ^{M}ta^{MH}	middle pitch ***!*lower pitch** *higher pitch	*semi-slack vocal folds *stiff vocal folds
c	aɾ^{M}ta^{HLH}	middle pitch ***!lower pitch** *higher pitch	*semi-slack vocal folds *stiff vocal folds *slack vocal folds *stiff vocal folds

(23)   <u>What's universal, and what's not in phonology</u>?

<u>universal</u>:
(1) Phonetic (real-world physical) constraints, and
(2) Abstract functional constraints such as contrast maintenance

These may be formalized with constraint families such as **recover** and **economize**, and

(3) Historical change rooted in (1) and (2)

These may be formalized with standard SPE-type rule ordering.

(4) Pattern coherence.

All in necessary combination

<u>not</u>:
The constraints themselves (cf. standard OT, in which *every* constraint is present in *every* language).

(24)   <u>What can be conflated, and what can't in phonology?</u>

<u>can be conflated</u>:
Formalism and functionalism

<u>can't</u>:
The principles which underlie sound patterning and the principles which govern the mental organization of these patterns.

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