Complex tone sandhi types in the Chinese Wu dialect of Huangyan

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Tone sandhi is frequently asymmetric – one tone changes, another remains unchanged. These asymmetries allow us to investigate how phonology represents and assesses tonal sequences. This study focuses on tone sandhi patterns in the Sinitic Southern Wu dialect of Huangyan (黄岩), where final syllables are commonly realized faithfully and initial syllables are modified based on complex sandhi rules (right dominance; Rose & Yang, 2023). That said, there are exceptions. They include words where only final tones change (left dominance), words where both initial and final tones change (both change), and words with no sandhi at all (no change). These exceptions can be systematically explained through a sandhi system that assesses syllable position as well as tonal constraints that determine the output of lexical tone sandhi.

Background. Huangyan Wu has eight tones in the tonal inventory for monosyllabic words (Table 1; modified slightly from van de Weijer et al., 2023). They can be represented using Chao five-point tone letters (Chao, 1930), with 1 and 5 representing the lowest and highest pitch respectively: high-mid falling 42, low falling 21, high falling 51, mid falling 31, high level 44, low rising 13, short high 5, and short low 2. They fall into four Middle Chinese tonal categories, each with one tone in the upper register (*yin*; A1, B1, C1, D1) of modal phonation and its counterpart in the lower register (*yang*; A2, B2, C2, D2) of breathy phonation.

Table 1. Base tones in Huangyan Wu (T for tone; rows for register; columns for tonal category)

Register	Macro tonal categories			
	A (*ping*)	B (*shang*)	C (*qu*)	D (*ru*)
1. upper (*yin*)	A1 /42/ mid-high falling [toŋ^{42}] ‘east’	B1 /51/ high falling [toŋ^{51}] ‘understand’	C1 /44/ high level [toŋ^{55}] ‘freeze’	D1 /5/ short high [toʔ^{5}] ‘supervise’
2. lower (*yang*)	A2 /21/ low falling [d̥oŋ^{21}] ‘same’	B2 /31/ mid falling [d̥oŋ^{31}] ‘move’	C2 /13/ low rising [d̥oŋ^{13}] ‘hole’	D2 /2/ short low [d̥oʔ^{2}] ‘read’

Sandhi types. We build on the first sketch of sandhi in Huangyan by Qian (1992) and control for potential morphosyntactic factors on sandhi types by limiting our investigation to disyllabic lexical nominals. Right dominance is the most common sandhi type for disyllabic words in Huangyan (Table 2), which is typical of lexical sandhi in Southern Wu dialects. Strikingly, all four types are found in lexical sandhi of Huangyan, including left dominance found in Northern Wu (Zhang, 2007, 2014).

Table 2. Sandhi of possible disyllabic combinations in Huangyan (unchanged syllable in bold)

Sandhi type	Right-dominant	Left-dominant	Both change	No change	Total
Example	xəʔ mi ‘black rice’ /5 31/ [3 **31**]	ɦo̱ʔ tʊ̃ ‘school’ /2 21/ [**2** ^{3}51]	sɛ s͡ɯ ‘landscape’ /42 51/ [33 31]	lo̱u fi ‘toll’ /13 44/ [**13 44**]	
Count	32 (50%)	3 (4.7%)	23 (35.9%)	6 (9.4%)	64

Regular tonal behaviors. Three observations stand out for the initial syllable (σ1) in these disyllabic words (Table 3). First, the short high /5/ (D1) consistently neutralizes into a mid short /3/ word-initially, whereas the short low /2/ (D2) remains stable. Second, tones in category A and C undergo neutralization to varying degrees. In the upper register, the mid-high falling tone /42/ (A1) and the high level tone /44/ (C1) regularly neutralize to a mid-level [33] tone, whereas their lower register counterparts, the low falling tone /21/ (A2) and the low rising tone /13/ (C2), tend

to neutralize incompletely to a low-mid rising tone [23], with their register preserved. Lastly, tones in category B preserve their contours. The high falling tone /51/ (B1) and the mid falling tone /31/ (B2) both change to the mid-high falling tone [42] (A1) before falling tones and to the low falling tone [21] (A2) before non-falling tones. For the final syllable (σ2), all tones, except for the rising tone (C2), preserve their contours but may undergo phonetically motivated pitch modifications. This is evident in left-dominant sandhi cases (marked in yellow) within the A2 and B1 columns.

Table 3. Behaviors of basic tones in Huangyan Wu (unchanged/dominant syllable in bold)

$T_{σ1}\backslash T_{σ2}$		A1 /42/	A2 /21/	B1 /51/	B2 /31/	C1 /44/	C2 /13/	D1 /5/	D2 /2/
A	A1 /42/	[45$^{↑}$-21]	[33-^{3}51]	[33-31]	[33-**31**]	[33-**44**]	[33-44]	[33-**5**]	[33-3]
	A2 /21/	[25$^{↑}$-21]	[22-^{3}51]	[23-31]	[23-**31**]	[22-**44**]	[22-44]	[23-**5**]	[23-3]
B	B1 /51/	[42-**42**]	[44$^{↑}$-31]	[42-31]	[42-**31**]	[21-**44**]	[21-**13**]	[21-**5**]	[21-**2**]
	B2 /31/	[42-**42**]	[44$^{↑}$-31]	[42-31]	[42-**31**]	[21-**44**]	[21-**13**]	[21-**5**]	[21-**2**]
C	C1 /44/	[33-**42**]	[33-31]	[33-31]	[33-**31**]	[33-**44**]	[33-44]	[33-**5**]	[33-3]
	C2 /13/	[23-**42**]	[23-31]	[23-31]	[23-**31**]	[23-**44**]	[23-44]	[23-**5**]	[23-3]
D	D1 /5/	[3-**42**]	[**5**-51]	[3-31]	[3-**31**]	[3-**44**]	[3-**13**]	[3-**5**]	[3-**2**]
	D2 /2/	[**2-42**]	[**2**-^{3}51]	[**2**-31]	[**2-31**]	[**2-44**]	[**2-13**]	[**2-5**]	[**2-2**]

Accounting for irregular tonal behaviors. While superficially arbitrary, exceptions to the right-dominant sandhi type can be explained using phonological constraints in Table 4. Following Bao (1990, 1999), we assume two levels of tonal representation that are independent of each other: Register (Upper/Lower) and Contour (high/low). Constraints 3 (*[+Upper][+Upper]) assesses Register in the tonal representation, while 1 (*OCP-Contour) and 2 (*fall-rise) assess Contour in the same representation. Most of the constraints proposed are reminiscent of the Obligatory Contour Principle (Leben 1973; Yip 1988), either at the Contour level (constraints 1) or at the Register level (constraints 3). Take *ɛəu*^{51}-*tʰɒ*^{44} 'glove' as an example. Both tones 51 and 44 are in the upper register, which violate *[+Upper][+Upper], so to avoid this contour constraint, the first tone changes to the lower register without changing its contour. This supports that sandhi rules can independently target Register without impacting Contour (Bao 1999).

Table 4. Contour and Register constraints for Huangyan Wu (H=high; M=mid; L=low)

Constraints	**Definition**	**Examples**
1 *OCP-Contour	Avoid successive identical contour tones	A1+A1: /42 42/→[45$^{↑}$ 21]
2 *fall-rise	Avoid fall-rise contours	A1+C2: /42 13/→[33 44]
3 *[+Upper][+Upper]	Avoid successive upper-register tones	B1+C1: /51 44/→[21 44]

Implication. The tone sandhi system in Huangyan Wu is phonetically motivated, as word-initial contour tones tend to be neutralized to level tones. Exceptions to these patterns can be attributed to the stability of a specific tone (e.g., D2) or to the existence of constraints on output tones (cf. Table 4). Words where both initial and final tones change can be explained through a mechanism where the dominant final tone requires further sandhi to satisfy the constraints on the output tones. Words with no tonal changes do not violate constraints to begin with and consequently do not undergo sandhi.

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