

Second, metathesis also appears to be invisible to other phonology. In both languages, other phonology acts as if metathesis has not occurred. For instance, speakers of Sevillian Spanish assess metathesized /st/ sequences that are realized as [th] as if they were still coda-onset sequences ([pas.ta]), even when the surface form resyllabifies [th] as an onset ([pa.tha]). Similarly, Uab Meto speakers treat metathesized /CV/ → [VC] sequences as codaless, even though they are consonant-final on the surface. Metathesized sequences are uniformly treated as matching their underlying precedence order, rather than surface order. In this sense, the rest of phonology is blind to metathesis. Under our account, metathesis is late phonology implemented via gestural overlap, and is invisible to early phonology.

In other words, we argue that metathesis is both late and fake. Metathesis is late because it manipulates gestures rather than segments and is invisible to other phonology. Metathesis is fake because it is phonetically incomplete, and is not true transposition. That is, because it occurs via gestural overlap, it does not transpose atomic segments.

The paper is structured as follows: Section 2 introduces the case study on Sevillian Spanish. Section 3 covers the case study on Uab Meto. Section 4 discusses the implications of the early/late phonology distinction, predictions our account makes, and possible alternative analyses. Section 5 concludes.

2 Case Study 1: Sevillian Spanish (CC metathesis)

Sevillian Spanish has productive CC metathesis in /sp st sk/ clusters (Torreira, 2007; O'Neill, 2010; Torreira, 2012; Horn, 2013; Ruch and Harrington, 2014; Ruch and Peters, 2016). In these clusters, coda /s/ debuccalizes to [h], and metathesizes with the following consonant (2). Metathesis is an ongoing change in progress, most advanced among younger speakers (Ruch and Harrington, 2014; Ruch and Peters, 2016).

(2) h-stop → stop-h in Sevillian Spanish

- (a) /'tʃispa/ [tʃihpa] → [tʃipha] 'spark'
- (b) /'pista/ [pihta] → [pitha] 'track'
- (c) /'boske/ [bohke] → [bokhe] 'forest'

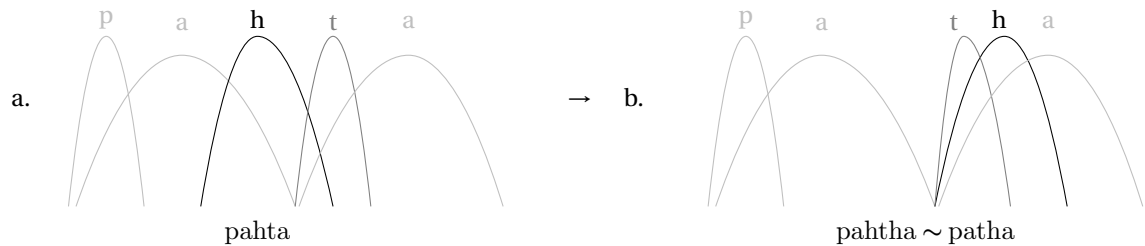
The motivation behind metathesis is not settled. It may be due to pressures of gestural coordination (Parrell, 2012), perceptual factors (Ruch and Peters, 2016), or a general pressure against coda obstruents (Moya Corral and Tejada Giráldez, 2020), which are dispreferred in many dialects of Spanish (see Mason 1994 for overview). Regardless of the cause, metathesis is a good solution for the problem posed by coda /s/: it results in an open syllable by removing the coda, while retaining some of that segment's features. Metathesis is also variable and co-occurs with other forms, including those that have coda /s/ retention ([tʃispa] 'spark'), debuccalization and/or gemination of the following consonant ([tʃihp(:)a]), deletion of /s/ and/or gemination ([tʃip(:)a]), and [h] split across the consonant ([tʃihpha]) (Ruch, 2008:33-4). Coda /s/ is dispreferred, and metathesis is the most prevalent—but not the only—solution.

As the change towards metathesis progresses, two options for representation arise: [Ch] may be a metathesized version of an underlying /sC/ sequence, or it may be an aspirated stop /C^h/. Previous work has argued, based on phonetic and phonotactic data, that [Ch] may be represented as an aspirated stop, or moving in this direction (O'Neill, 2009; Gylfadottir, 2015). However, experimental work in (Gilbert, In revision) suggests that listeners treat [Ch] as separable sequences that still have the underlying order /sC/, and we treat them as such in this paper.

We propose that productive metathesis in Sevillian /sC/ clusters occurs via gestural overlap (following Torreira 2007, 2012; Parrell 2012; Cronenberg et al. 2020) and late in the phonology. Evidence that metathesis is overlap comes from the presence of forms that are phonetically intermediate between unmetathesized and metathesized forms, and from forms that show other phonetic effects of overlap (Section 2.1). Evidence that metathesis occurs late comes from an experiment testing the interaction between metathesis and stress (Section 2.2). Because metathesis changes the syllable structure ([tʃis.pa] → [tʃi.pha]), it could affect listeners' judgments of acceptable stress patterns. To preview, Sevillian listeners judge stress patterns as if metathesis has not occurred, indicating that metathesis is invisible to early phonology (stress).

2.1 Phonetics Metathesis in Sevillian can be understood as gestural overlap (Torreira, 2007, 2012; Parrell, 2012; Cronenberg et al., 2020). Figure 3 illustrates that apparent metathesis can occur when the [h] gesture slides across the gesture of the following consonant [t], so that [h] starts at the same time as [t] and extends beyond its release. The final result is full metathesis, where the [h] gesture continues past the release of [t].

(3) Gestural score for Sevillian metathesis: [h] slides across [t] (following Parrell 2012)



Parrell (2012) argues that metathesis may occur due to pressures of gestural coordination. In-phase gestural coordination—where gestures start at the same time, as in [Ch]—is easier than anti-phase coordination, where one gesture starts before the other ([hC]).

Regardless of the cause, this account is consistent with phonetically intermediate forms, where the [h] gesture is split across the consonant in the process of full metathesis. These forms do occur in Sevillian Spanish, as illustrated in Figure 1, *costa* (/kosta/). In this word, portions of [h] both precede and follow [t]. Split forms constitute around 11% of productions in conversational speech (Ruch, 2008), and their existence provides evidence that metathesis is not a discrete process that transposes segments in one fell swoop. Instead, one gesture moves across another.

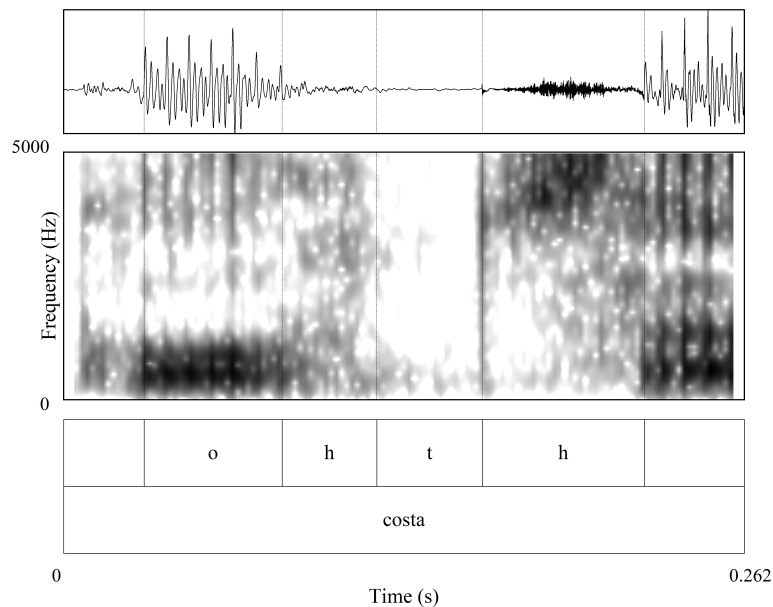


Figure 1: Spectrogram of gradual metathesis (/kosta/ → [kohtha])

There are two further sources of evidence that metathesis occurs via overlap. First, in /sp st sk/ metathesized clusters ([VChV]), /ptk/ may resist passive intervocalic voicing more than intervocalic voiceless stops ([VCV]) (O'Neill, 2010). This falls out if metathesis is gestural overlap: the gesture for [h] overlaps the closure gesture for [ptk], preventing passive voicing. Second, the behavior of /sb sd sg/ clusters indicates gestural overlap, even though these clusters do not show full metathesis. In Spanish,

voiced stops /bdg/ spirantize in all positions (e.g. /kaɰa/ → [kaɰa] ‘each’; /alβa/ → [alβa] ‘dawn’), except for following a homorganic nasal, liquid or pause (e.g. /alɰea/ → [alɰea] ‘town’; /βino/ → [βino] ‘wine’). In many varieties, spirantized /bdg/ have very little constriction (e.g. Argentinian, Colantoni and Marinescu 2010). In Seville and other areas of Southern Spain, /sb sd sg/ are substantially more constricted and noisier than than spirantized intervocalic /bdg/ (Romero, 1995; Gilbert, 2020). These differences have been reported for other varieties of Spanish as well (e.g. Chilean, Rogers 2016). Figures 2 and 3 illustrate the difference between intervocalic /b/ (/re'baɰjas/) and an /sb/ cluster (/res'baɰla/). The intensity curves show that /sb/ has a much stronger constriction degree; there is also more frication in the waveform (not visible). Overlap of the /s/ and /bdg/ gestures would result in precisely these effects, because the tongue tip is closer to the alveolar ridge, creating both more constriction and sibilance.

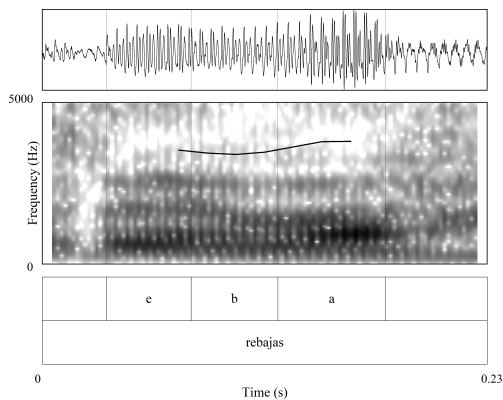


Figure 2: Intensity contour for /re'baɰjas/

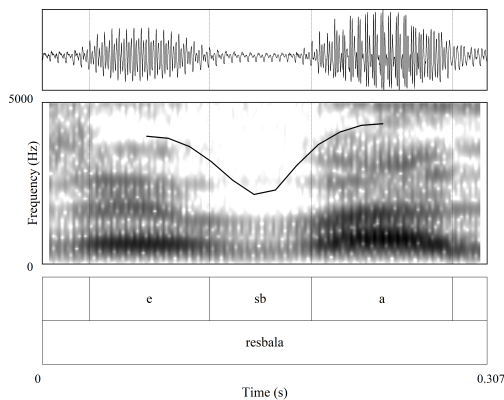


Figure 3: Intensity contour for /res'baɰla/

Phonetic evidence indicates that metathesis occurs when the /s/ gesture overlaps with the gesture of the following consonant. With voiceless stop clusters, the gestural realignment is either partial, splitting [h] across the stop, or full, placing [h] entirely on the other side of the stop. With voiced stop clusters, metathesis is partial, but the higher constriction degree and frication in /sb sd sg/ sequences (as compared to intervocalic /bdg/) suggest a similar process of realignment and overlap. Metathesis may be only partial in /sb sd sg/ sequences due to perceptual factors. Voiceless stop releases are salient places to ‘dock’ aspiration (Kingston, 1990), resulting in what appears to be full metathesis. Voiced stops in Spanish are spirantized, and the releases are not as salient as those of voiceless stops. Spirantized voiced stops may pattern with continuants in other languages, where glottal features are aligned earlier in the segment, rather than to the release (Kingston, 1990).

2.2 Phonological interactions Phonetic data suggest that metathesis occurs late in the phonology by gestural realignment; how metathesis interacts with other phonological processes suggests that this gestural metathesis does not change the underlying order of segments, and is not visible to other phonological operations.

In recent experimental work, Gilbert (In preparation) tests the interaction between stress and metathesis. Spanish stress is partially weight-sensitive, and speakers apply weight-based restrictions in experimental tasks. One restriction in the Spanish lexicon is that antepenultimate stress does not occur on words with heavy penults (4). In a stress judgment experiment, Fuchs (2018) finds that listeners apply this restriction productively, dispreferring nonce words of this shape.

- (4) Restriction: Antepenultimate stress is prohibited when the penult is heavy (Harris, 1983).
(*CV.CVC.CV.CV)

This restriction provides a way to test how metathesis affects other aspects of the phonological system. If [Ch] sequences are underlyingly /sC/ clusters, then there is a mismatch between syllable structure before

and after metathesis, as illustrated in (5). Syllables that are closed by /s/ (heavy) become open (light) once metathesis occurs.

(5) Metathesis changes syllable structure

- (a) [mis.ti.ko] $\acute{H}LL$ ‘mystic(al)’
 (b) [mi.thi.ko] $\acute{L}LL$ ‘mystic(al)’

This mismatch could affect stress. If stress treats syllables following [Ch] as heavy, then stress is evaluated and assigned on a form where /s/ remains in-situ (5 a). Conversely, if stress treats these syllables as light, then stress is assigned and evaluated on a form where metathesis has occurred (5 b).

In a forced-choice stress judgment task using nonce words (Gilbert, In preparation), Sevillian listeners chose which word they preferred out of two options presented auditorily. The nonce words consisted of four syllables and all had antepenultimate stress. They were constructed in sets, such that the members of each set differed only in the type of penultimate syllable (Table 1). To target differences in the weight of the penult, the two words always came from the same set.

Table 1: Example nonce word set

	NoCoda	CodaS	CodaH	CodaSonorant	Metathesis
Word	lu'mafato	lu'mafasto	lu'mafahto	lu'mafanto	lu'mafatho
Surface Penult	CV	CVC	CVC	CVC	CV

Results show that speakers treat syllables with metathesis as if they were heavy, for the purposes of stress. Speakers preferred antepenultimate stress words that had underlyingly light and surface light penults (2a), over those that had any kind of heavy penult (2b). This includes words with metathesis, which have underlyingly heavy—but surface light—penults.

Table 2: Sevillian listeners' preferences: UR light vs. UR heavy penult

NoCoda	a.	/lumafato/ [lu'mafato]	/LLLL/ [ĹLLL]	>	b.	/lumafasto/ [lu'mafasto]	/LLHL/ [ĹHL]	CodaS
						/lu'mafahto/ [lu'mafahto]	/LĹHL/ [ĹHL]	CodaH
						/lu'mafanto/ [lu'mafanto]	/ĹLHL/ [ĹHL]	CodaSonorant
						/lu'mafasto/ [lu'mafatho]	/ĹLHL/ [ĹLL]	Metathesis

Furthermore, listeners dislike antepenultimate stress equally in words with underlyingly heavy but surface light penults (Table 3a) and in words with underlyingly and surface heavy penults (Table 3b). In other words, they treat penults with any kind of coda as equally unacceptable.

Table 3: Sevillian listeners' preferences: UR light vs. UR heavy penult

Metathesis	a.	/lumafasto/ [lu'mafatho]	/LLHL/ [ĹLL]	=	b.	/lumafasto/ [lu'mafasto]	/LLHL/ [ĹHL]	CodaS
						/lu'mafasto/ [lu'mafahto]	/ĹLHL/ [ĹHL]	CodaH
						/lu'mafanto/ [lu'mafanto]	/ĹLHL/ [ĹHL]	CodaSonorant

Metathesis does not affect syllable weight for the purposes of stress assignment. Even in forms where [h] has metathesized out of coda position, listeners treat this syllable as heavy. Listeners evaluate stress based on the syllable structure of the underlying form as if metathesis has not occurred. Stress is early phonology, and changes that occur in late phonology—gestural reorganization resulting in metathesis—are not visible to it.

3 Case Study 2: Uab Meto (CV metathesis)

Uab Meto (Austronesian, West Timor) has productive CV metathesis that is prosodically driven (Mooney, 2021). To reduce stress lapses, the final syllable of a root can delete. In most cases, this causes the deleted vowel to coalesce leftwards onto the previous syllable.

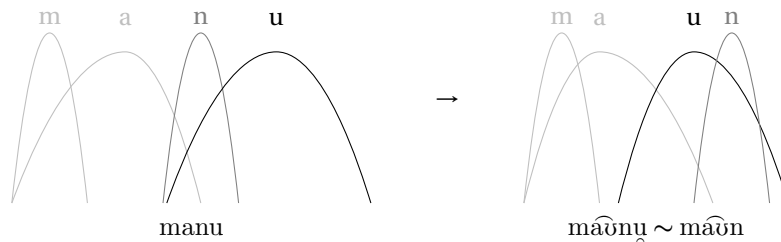
(6)	(a)	/manus/	→ manus	‘betel vine’	$\acute{\sigma}\sigma \rightarrow \acute{\sigma}\sigma$
	(b)	/manus-es/	→ ma [̂] ʊns-es	‘a betel vine’	$\acute{\sigma}\sigma\sigma \rightarrow \acute{\sigma}\sigma$
(7)	(a)	/bakaseʔ/	→ bakaseʔ	‘horse’	$\acute{\sigma}\sigma \rightarrow \acute{\sigma}\sigma$
	(b)	/bakaseʔ-e/	→ baka [̂] ænsʔ-e	‘the horse’	$\acute{\sigma}\sigma\sigma \rightarrow \acute{\sigma}\sigma$
(8)	(a)	/ʔa- ¹ mepo-t/	→ ʔa- ¹ mepo-t	‘worker’	$\sigma\acute{\sigma}\sigma \rightarrow \sigma\acute{\sigma}\sigma$
	(b)	/ʔa- ¹ mepo-t-in/	→ ʔa- ¹ m [̂] ɛp-t-in	‘workers’	$\sigma\acute{\sigma}\sigma\sigma \rightarrow \sigma\acute{\sigma}\sigma$
	(c)	/ʔa- ¹ mepo-t-in-e/	→ ʔa- ¹ m [̂] ɛp-t-in-e	‘the workers’	$\sigma\acute{\sigma}\sigma\sigma\sigma \rightarrow \sigma\acute{\sigma}\sigma\sigma$

Despite being described as metathesis (Blevins and Garrett, 1998; Edwards, 2016), Uab Meto metathesis is best analyzed as a type of coalescence implemented via gestural overlap, not transposition. In the coming sections, we review language-internal phonetic and phonological evidence that supports this analysis.

3.1 Phonetics In comparison to the Sevillian Spanish pattern, we may have thought that Uab Meto metathesis should have less gradient realization, since it occurs in response to prosodic pressures rather than gestural ones like NO CODA. However, this turns out not to be the case. The important thing in both Sevillian Spanish and Uab Meto is that these are coalescence alternations, and therefore the phonetics provides gradient realization despite their triggers being at different levels of phonological representation (no coda vs. prosody).

I therefore analyze Meto metathesis as gestural overlap, as in (9). Prosodic pressures force the root-final V gesture to become anti-phase.

(9) Gestural score for Uab Meto metathesis



Anti-phase relationships like those in (9) are known to be less stable than in-phase ones (de Jong et al., 2002), and this creates *intermediate forms*. Figure 4 shows an example of an intermediate form. The [u] gesture has slid leftwards, coalescing into the preceding syllable, but an excrescent vowel remains in its original position to the right of the [n].

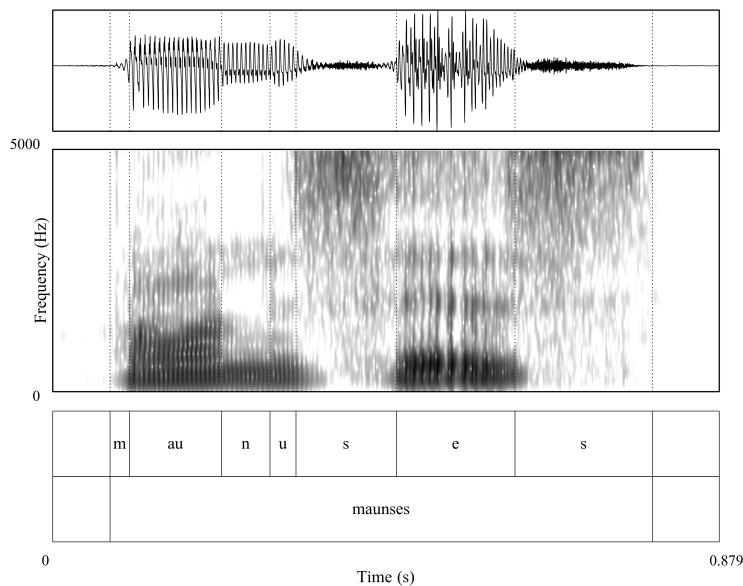


Figure 4: Spectrogram of gradual metathesis (/manus-es/ → [m^hau^hn^hus-es])

Intermediate forms similar to this have also been reported for Leti (Renhard Saupia, p.c.), a closely related Austronesian language.¹

Even when metathesis appears complete, Meto metathesis creates sequences that have greater-than-normal consonant-vowel coarticulation. By analyzing metathesis as gestural overlap, this pattern is predicted, because the coalescing vowel fully overlaps the intervening consonant.

In (10 a)-(10 b), we see an example of this through differences in /s/ palatalization. An underlying CVVC form has very little vowel-consonant overlap, and so /s/ is not palatalized in (10 a). By contrast, the /s/ and /i/ fully overlap during metathesis in (10 b), and so the sibilant may be palatalized.

(10) CV metathesis increases consonant-vowel coarticulation

- | | | | |
|-----|--------------------------------------|-----------------------|-------------------------------|
| (a) | tai-s | ‘sarong’ | *tais ^j |
| (b) | tais ^j ~ tai ^s | ‘sea (phrase-medial)’ | cf. tasi ‘sea (phrase-final)’ |

If metathesis were transposition, we would not expect to see higher-than-normal overlap in these sequences, because the segments should be perfectly reordered. In the next section, we review complementary phonological evidence that supports this view of metathesis as overlap rather than transposition.

3.2 Phonological interactions In the phonology, we also see evidence that Meto metathesis does not truly change precedence relations, and instead is better analyzed as coalescing gestural overlap. We examine data from two areas: (i) that metathesis cannot create true codas, and (ii) that metathesis cannot resolve vowel hiatus violations.

In Meto, word-final codas are only permitted when they occur *after* a phonological phrase’s primary stress. Word-final codas that are pretonic will be deleted, as in (11):

(11) Pretonic coda deletion

- | | | | |
|-----|---------------|------------------------------|----------------|
| (a) | /tai-s metan/ | → [t ^h ai ‘metan] | ‘black sarong’ |
| (b) | /fof leko/ | → [fo ‘leko] | ‘good smell’ |

¹ In Kwara’ae, another related language, intermediate forms have also been observed. Focused phrase-final words may surface as intermediate forms (e.g. /le.ʔa/ → [le.ʔa] ‘good’, Heinz 2005: 35). We can understand the Kwara’ae pattern as overlap without deletion of the following syllable.

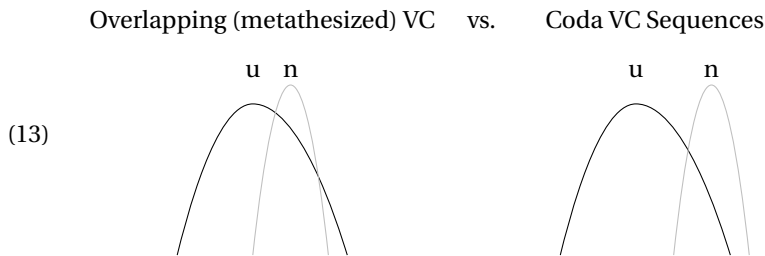
- (c) /snaen mutiʔ/ → [snaē 'mutiʔ] 'white sand'
 (d) /kokis moloʔ/ → [kōik 'moloʔ] 'yellow bread'
 (e) /ʔa-mepo-t lele/ → [ʔa-mēop 'lele] 'field worker'

However, metathesized codas are mysteriously immune to this restriction, as in (12). This suggests that metathesis does not create a coda that can be recognized by early phonology, because otherwise we would expect for these forms to either (a) undergo coda deletion (*[tāi 'metan]), or (b) block metathesis to avoid the coda in the first place (*[tasi 'metan]).

(12) No coda deletion in metathesized forms

- (a) /tasi metan/ → [tāis 'metan] 'black sea' *[tāi 'metan], *[tasi 'metan]
 (b) /manu mutiʔ/ → [māūn 'mutiʔ] 'white chicken' *[māū 'mutiʔ], *[manu 'mutiʔ]
 (c) /kolo-ʔane/ → [kol-'ʔane] 'finch' *[ko-'ʔane], *[kolo-'ʔane]
 (d) /napan moloʔ/ → [nap 'moloʔ] 'yellow butterfly' *[na 'moloʔ], *[napa 'moloʔ]

When considered alongside the phonetic data from Section 3.1, this is unsurprising. Metathesized vowels end either at the same time as the consonant, or just after, which creates intermediate forms. What this shows us is that the phonology has access to a representation that recognizes the difference between coda VC and non-coda VC sequences. When treating metathesis as gestural overlap, this representational distinction is straightforward to make, as in (13):



In comparison, a transposition-based model would need to appeal to some other mechanism to account for these facts. Metathesis should perfectly reorder the segments, and so Output-Output faith or rule ordering would be needed to prevent metathesis from feeding coda deletion. While these mechanisms are adequate in a formal setting, they do not predict the phonetic facts, which are that metathesized VC sequences are not phonetic codas either. This leads to a puzzle: what is transposition if it can't actually change the prosodic status of the transposed segments? From this, it seems prudent to conclude that what we are witnessing is not true transposition – rather than perfect reordering, Meto metathesis is gestural overlap.

Another area that supports metathesis as gestural overlap is hiatus resolution. In Uab Meto, vowel hiatus is not permitted across a morpheme boundary. This invariably triggers consonant epenthesis, shown in (14). Epenthetic consonants are underlined.

(14) Consonant epenthesis resolves vowel hiatus

Kotos Amarasi, Oekabiti speaker

- (a) /meo-e/ → meōg-e 'the cat'
 (b) /fatu-e/ → fāūtg-e 'the stone' *[fāūt-e]
 (c) /kero-e/ → keōrg-e 'the monkey' *[keōr-e]
 (d) /tasi-e/ → tāisg-e 'the sea' *[tāis-e]
 (e) /roti-e/ → roitg-e 'the bread' *[roit-e]

Notably, metathesis occurs alongside consonant epenthesis in (14b.-e.). In a transposition-based analysis in Optimality Theory, again, this is puzzling: why do we have *both* consonant epenthesis and metathesis in (14b.-e.), when metathesis alone should be enough? This problem is illustrated in (15). Regardless of the ranking of DEP-C and LIN, the desired candidate d. is harmonically bound by candidates b. ($[\ast\text{fatug-}e]$) and c. ($[\ast\text{fa}\widehat{u}t-e]$).

	/fatu-e/	*V-V	DEP-C	LIN
	a. fatu-e	*!		
(15)	⦿ b. fatug-e		*	
	⦿ c. fa \widehat{u} t-e			*
	⊕ d. fa \widehat{u} tg-e		*	*

These problems are not insurmountable; they could be readily fixed by appealing to a serial derivation or output-output faithfulness (see Section 4.3). But why should rule order be so crucial when a language does not prioritize distinctions in precedence?

By contrast, analyzing metathesis as gestural overlap provides explanatory adequacy as well as formal elegance. When a CV sequence metathesizes to VC, the vowel gesture remains anchored *after* the consonant, as in (13) above. It is therefore unsurprising that metathesis alone cannot repair vowel hiatus, because metathesis will not change the relative configuration of the vowel gestures.

3.3 Summary To summarize, Uab Meto metathesis is prosodically driven, but nonetheless bears close similarities to metathesis in Sevillian Spanish. In both languages, metathesis is phonetically realized as gestural overlap and regularly produces intermediate forms. Metathesis also does not seem to change precedence relationships from the perspective of the phonology — other phonological operations behave as if the segments remain in their original positions. In Sevillian Spanish, metathesis does not change syllable weight for the purposes of stress assignment. In Meto, metathesis cannot repair vowel hiatus. In this sense, metathesis is invisible to these other phonological distinctions. Lastly, metathesis in both languages is predictable from surface phonotactics alone, and is not morpheme-specific. This fact provides further evidence that this type of productive metathesis needs analysis within phonology proper, not morphology.

4 Discussion

In this section, we now turn to implications of the present proposal. Section 4.1 discusses the architecture of early and late phonology, Section 4.2 lays out testable predictions of our framework, and Section 4.3 discusses alternative analyses.

4.1 The structure of (early and late) phonology In this paper, we've argued that the gestural overlap involved in metathesis is *late phonology*. Late phonology is a component of phonology that manipulates gestures directly rather than atomic (segmental) representations. As such, we expect late phonology to produce alternations that show phonetic gradience and are invisible to early phonology.

(16) Diagnostics for early vs. late phonology:

- (a) Diagnostic #1. Late phonology has gradient phonetic implementations
- (b) Diagnostic #2. Late phonology cannot feed phonology that uses atomic representations

The idea of “early” and “late” phonology bears intuitive similarities to proposals in Lexical Phonology (Mohan, 1982; Kiparsky, 1982; Kaisse and Shaw, 1985). Lexical Phonology posits that there are two main classes of phonological rules, lexical and postlexical. Lexical rules are morpheme-specific and apply in cycles before domain-general postlexical rules may apply. However, we do not treat early and late phonology as a direct extension of this lexical/postlexical distinction. In our model, early and late phonology are mainly distinguished by the representations they use—segments versus gestures—not the morphological specificity of the rule. What our model of late/early phonology shares with Lexical Phonology is that there is an asymmetry in how information is shared between the strata: early

phonology may feed/bleed other early phonology, but late phonology can never feed early phonology, just as postlexical rules may not feed lexical rules. Note that this does not require late phonology to occur *literally after* early phonology, but simply for the output of late phonology to be inaccessible or invisible to early phonology. One way to implement this would be to posit a C/V skeleton as in Gafos (1999: 66–67), where association lines are used to indicate gestural overlap. In this framework, constraints that induce early phonology cannot reference association lines. This means that late phonology has no way of feeding early phonology, since their constraints never interact.

A similar distinction has been proposed for vowel epenthesis, based on similar reasoning. Hall (2006) divides epenthetic vowels into two categories: epenthetic vowels vs. intrusive vowels. In a large-scale cross-linguistic survey, she notes that the two types of vowels consistently behave differently and that certain properties cluster together. Intrusive vowels are often invisible to other phonological processes and do not count as syllable nuclei (they are invisible to e.g. stress); they are copy vowels or schwa-like, and can be affected by surrounding segments; they tend to be optional, variable, and conditioned by speech rate; and they do not function to repair illicit structures (Hall, 2006:391). In contrast, epenthetic vowels count as syllable nuclei (e.g. for stress), have a fixed quality or are copied from an adjacent vowel, are more consistently present, and repair marked structures. A strictly temporal difference between these types of epenthetic vowels does not fully capture the correlations between properties. Instead, Hall argues that intrusive vowels arise due to changes in the gestural coordination of consonants. Intrusive vowels are ‘purely a phenomenon of the gestural level’, while epenthetic vowels are added to the representation at the segmental level. A gestural explanation explains why intrusive vowels do not feed most other phonological processes (they arise at the gestural level, which is not visible to other representational levels), why they show phonetic effects of surrounding segments (coarticulation), and why they are variable and conditioned by speech rate (speech rate affects gestural timing).

Our distinction of *early* vs. *late* phonology for metathesis makes many of these same assumptions — specifically, that the reason metathesis does not interact with other phonological processes is that it occurs at the gestural level of representation, which is not visible to other levels. Metathesis is gestural, just like Hall’s intrusive vowels. However, there appears to be no operation analogous to epenthetic vowels: metathesis can never transpose segments. As such, metathesis is more restricted. As we saw in Sevillian Spanish and Uab Meto, metathesis can be implemented gradiently and both languages show a conspicuous lack of interaction between metathesis and other phonology like stress, epenthesis, and deletion. In both languages, metathesis is also blind to stress (see Section 4.3 for other languages). By both diagnostics from (16a–b) and the similarities with Hall’s intrusive vowels, metathesis is late phonology that operates on gestural representations.

4.2 Predictions Based on our findings from metathesis in two unrelated languages, we make the following predictions. While these are strongly-worded, we aim to provide testable—and falsifiable—hypotheses for future investigation. Recall that our focus is on *synchronic, productive metathesis*, excluding metathesis that is morphologically conditioned.

(17) Predictions:

- (a) When metathesis is synchronically productive (and predictable based on surface factors), there should be evidence of gestural overlap or intermediate forms.
- (b) No language should have predictable phonological metathesis that affects stress assignment.

First, we predict that all languages with productive synchronic metathesis should also show phonetic gradience in the form of gestural overlap or intermediate outcomes. Outside of our preliminary results on Meto and Sevillian Spanish, existing studies do not look at the phonetics of metathesis in other languages. To confirm this prediction, phonetic work will be needed.

Second, we predict that stress assignment will always ignore metathesis. We assume that stress assignment must occur over some type of atomic representation, be it syllables, grids, or segments, and so all stress phonology must be early phonology. The reason then, why all metathesis has this fixed (late) relationship to stress is twofold:

1. Stress operates over atomic representations, and so stress is always early phonology

2. Metathesis can only occur via gestural overlap and so it requires gestural representations that are strictly the purview of late phonology

Together, these mean that metathesis should always appear to occur after stress assignment. In the architecture of the phonetics-phonology interface, this can be implemented in several ways: (i) stress assignment changes atomic representations into gestural ones, (ii) all representations exist in parallel, but gestural representations are simply invisible to atomic ones, or (iii) gestural representations are only produced after stress assignment, and so metathesis occurs literally after stress assignment but possibly in parallel with other early phonology.² Among these, we remain agnostic as to the exact implementation, since all of them are consistent with dividing phonology into early and late categories.

So far, this prediction seems to be robustly supported by the typology. Based on a small typological survey, we found that eight languages with productive, synchronic metathesis have metathesis *after* stress assignment: Balangao (Yoon, 2012; Canfield, 2016); Cherokee (Blevins and Garrett, 1998); Faroese (Seo and Hume, 2001); Gujarati (Cardona, 1965; Yoon, 2012); Kwara'ae (Sohn, 1980; Heinz, 2005); Leti (van Engelenhoven, 2004; Hume, 1998); Lithuanian (Kenstowicz, 1971; Seo and Hume, 2001); and Nivacle (Gutiérrez, 2020).

4.3 Alternatives There are several possible alternatives to the analysis we have presented here: transposition in Parallel OT, serialism, and Lexical Phonology. We now go through each of these in turn.

The first alternative is to say that transposition does exist, and that LINEARITY or adjacency-preserving constraints can compel metathesis in Parallel OT. The phonetically gradient output of metathesis could arise through output-output faithfulness. The core problem with such an approach is that transposition overgenerates in Parallel OT (cf. McCarthy 2000; Takahashi 2019; Mooney 2021). Provided LINEARITY is dominated, the degree of violation should not matter, and so dominated LINEARITY predicts long-distance metathesis, which is typologically unattested.

A second alternative is to instead appeal to a serial framework such as Harmonic Serialism. In this alternative, segments could transpose through a fuse-and-split approach as proposed in Takahashi (2019), where the intermediate stages of the derivation induce phonetic gradience. The issue here is that this predicts that any phonological process derived serially should show the possibility for phonetic gradience. This places a large empirical burden on any derivation in Harmonic Serialism, since then we would expect to find phonetic evidence of intermediate stages in a variety of phenomena, which may not be desirable.

A third and final alternative is to say that early and late phonology is an extension of the lexical/postlexical distinction from Lexical Phonology (Mohan, 1982; Kiparsky, 1982). Under this alternative, metathesis is a postlexical rule, which is why it cannot be fed by earlier, lexical phonology. The core problem for this analysis is that metathesis is still sensitive to morphological boundaries in Uab Meto, which should be removed via bracket erasure by the time postlexical phonology occurs. This suggests that metathesis cannot be postlexical in Uab Meto, even though metathesis can cross morpheme boundaries as expected in Sevillian Spanish. From this, we can conclude that the early/late distinction is something different than a domain restriction to a phonological word.

5 Conclusion

In this paper, we argue that metathesis, an underattested phonological operation, is best understood as gestural overlap. Based on two case studies (Sevillian Spanish and Uab Meto), we observe that metathesis is (i) implemented in a phonetically gradient way and (ii) invisible to other phonology. We use these observations to propose that phonology is bifurcated into two major strata: early phonology and late phonology. Early phonology uses atomic representations, whereas late phonology uses gestural representations. While early phonology must always feed into late phonology, the output of late phonology is never accessible to early phonology. Under this division, metathesis is therefore strictly late phonology because it uses gestures as its core representational unit. As late phonology, metathesis is therefore expected to be invisible to (early) phonological operations in these languages.

² See discussion of one possible implementation in Section 4.1, which uses Gafos (1999)'s C/V structure with association lines.

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