

Metathesis: Formal and Functional Considerations

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1. Introduction

The focus of this paper is on metathesis, the process whereby in certain languages, under certain conditions, sounds appear to switch positions with one another. Thus, in a string of sounds where we would expect the linear ordering of two sounds to be ...xy..., we find instead ...yx.... In the Austronesian language Leti, for example, the final segments of a word occur in the order vowel + consonant in some contexts, while as consonant + vowel in others, e.g. [kunis]/[kunsi] 'key'. While variation in the linear ordering of elements is typical in the domain of syntax, it is comparatively striking in phonology, differing in nature from most other phonological processes which are typically defined in terms of a single sound, or target, which undergoes a change in a specified context. Thus, the change from /nb/ to [mb] can be described in simple terms as place assimilation of the target /n/ in the context of a following /b/, thereby yielding [mb]; or, in traditional linear formalism, /n/ → [m]/ __[b]. In contrast, the reversal of sounds such as /sk/ → [ks], as attested in Faroese, defies such a simple formalism given that metathesis seems to involve two targets, with each essentially providing the context for the other. Due in part to the distinct nature of the process, metathesis has traditionally resisted a unified and explanatory account in phonological theory.

The apparently distinct nature of metathesis has also resulted in the perpetuation of, what one might refer to as, the "metathesis myth", the commonly held view of metathesis as sporadic and irregular, restricted to performance errors, child language or sound change. This view is regularly expressed in the linguistic literature, including the most up-to-date instructional texts and dictionaries, as evidenced by the following sampling of citations:

“[Metathesis] frequently occurs in all languages as a type of speech error and is a common feature of child phonology.” (Spencer 1996: 68). “Metatheses are well recognized in historical linguistics...but they can also be seen in performance errors, in such tongue-slips as *aks* for *ask*, or in the phenomenon of

‘spoonerisms’.” (Crystal 1997:240). “Metathesis has generally been treated as a minor sound change. Sporadic and irregular, examples of metathesis are often treated as if labeling it were explaining it.” (Powell 1985: 106). “Rules of metathesis are rarely productive. This is why they are most likely to be discussed from the point of view of historical linguistics; and even there, their sporadic nature gives them a definitely marginal character. Synchronically, metathesis is viewed more as a performance factor responsible for spoonerisms and other erratic surface deviations.” (Montreuil 1981: 67).

I would suggest that there are two principal factors at the root of this view, one relating to data, the other to theory. With respect to data, it seems that despite the fact that numerous cases of metathesis are reported in the literature, basic knowledge has been lacking concerning the full range of metatheses that are possible in language, under what conditions metathesis applies, why metathesis happens, and how metathesis interacts with other processes affecting sound structure. This information is critical to providing an accurate picture of the nature of metathesis. It is also of crucial importance for the advancement of phonological theory since without a clear understanding of the fundamental phonological processes possible in human language, developing an explanatory theory of sound systems is impossible.

The empirical basis for the study of metathesis has, however, seen an increase in recent years due to the accumulation of extensive cross-linguistic surveys (see e.g., Blevins & Garrett 1998, Hume 1998b, 2000, Mielke & Hume 2001, and references therein), in-depth studies of metathesis in individual languages (e.g. McCarthy 2000, Hume 1998a, Seo & Hume 2001), and experimental work exploring psycholinguistic influences on metathesis (e.g. Makashay 2001; Winters 2001). In this regard, it is also important to point out that a database of metathesis cases, housed at the Ohio State University Metathesis website,¹ is currently being developed. The database will ultimately contain details on all reported cases of metathesis with each language's entry including the following information: language name, language family, summary of metathesis, examples, motivation, related processes, references. These resources, added to the already existing body of literature on the subject (e.g. Grammont 1939, Hock 1985, Ultan 1978), are creating a solid empirical foundation for the study of metathesis.

From these works it is clear that while metathesis is less common than processes such as assimilation and sound deletion, it can nonetheless occur as a regular synchronic phonological

process in a wide range of languages. Moreover, it can be motivated by linguistically natural constraints on sound structure. For example, Hume 1998b, 2000 argues that a unified account of a wide variety of seemingly different types of metathesis is possible when perceptual factors are taken into account. In particular, reordering two sounds has the effect of enhancing the overall perceptibility of the sound sequence in question (see also Grammont 1939, Steriade 2001 and below for related discussion).

The second factor relating to the perpetuation of the "metathesis myth", I would suggest, relates to the nature of phonological theories. In both linear and nonlinear phonological theories, there is a principled reason to resist recognizing metathesis as a legitimate phonological process of segment reversal: extending the theory to account for the inherently distinct nature of metathesis has the potential of opening 'a Pandora's box of implausible-seeming...processes' (Janda 1984:92). Indeed, Webb (1974) claims that metathesis does not exist as a regular phonological process in synchronic grammar.

In early generative phonology, Chomsky & Halle (1968) proposed to formalize metathesis by means of the transformational notation in (1).

(1) s k
 1 2 2 1 Output: [ks]

Unrestricted rewrite rules of this nature are excessively powerful and unconstrained, however; virtually any operation could be formally described in these terms, whether attested or not. For example, while capable of describing attested cases of metathesis whereby adjacent sounds switch positions as in (1), transformational formalism fails to rule out unattested cases in which sounds switch over any number of consonants and vowels, e.g. $C_1V_2C_3V_4C_5V_6C_7$ $C_7V_2C_3V_4C_5V_6C_1$. The fact that linear formalism was inadequate to represent metathesis is not a sufficient argument for rejecting it as a basic operation, however. Deletion also required an unrestricted rewrite rule, yet it is unlikely that one would doubt the existence of deletion as a phonological process.²

Likewise, in more recent nonlinear phonology, metathesis has resisted a unified, explanatory treatment despite advancements in the formalism used to account for many other processes, such

¹ <http://www.ling.ohio-state.edu/~ehume/metathesis/>

as assimilation (Clements 1985) and dissimilation (Odden 1987). Unlike these phenomena, no unique formalism exists for characterizing metathesis as a primitive rule-type. Instead, “metathesis effects” have been derived by a variety of different means including: the successive application of rules of sound deletion and insertion (Besnier 1987, Hume 1991), feature spreading (Rice 1992), planar segregation (McCarthy 1989), template maximization (van der Hulst & van Engelenhoven 1995), and vowel epenthesis into degenerate syllables (Lyche 1995). Thus, from a theoretical perspective, metathesis ceased to exist as a distinct phonological process (Wanner 1989). More recently, Hume (1998a) also argues that some cases of consonant/consonant metathesis defy analysis given the accepted constructs of nonlinear theory, such as the No Line Crossing convention.

Thus, in linear and nonlinear phonological theories there is a principled reason to resist recognizing metathesis as a legitimate phonological process of segment reversal. As a result, both fail to provide the requisite formalism to account for metathesis in a constrained and unified manner. However, the development of Optimality Theory (OT), a constraint-based theory of phonology, provides a promising approach to the analysis of metathesis since not only are segment reversals possible between an input and output in the theory, they are predicted to exist (Prince & Smolensky 1993, McCarthy & Prince 1993; but especially McCarthy & Prince 1999). Metathesis results in part from a mismatch in the linear ordering of sounds between input and output, formally encoded as a violation of the constraint LINEARITY. Thus, unlike rule-based approaches, there is no longer a principled reason to reject the existence of metathesis; indeed, within an OT framework we have just the contrary. Since earlier theoretical frameworks have been unsuccessful in providing an explanatory account of the process, the study of metathesis provides an excellent testing-ground for a constraint-based approach to phonology. The issue, therefore, is not whether metathesis should be accounted for within a formal model of phonological theory but, rather, how to account for the wide range of observed metatheses in a constrained and unified manner.

The time is therefore ripe to further our understanding of metathesis, both in terms of the factors, linguistic and non-linguistic, which shape patterns of metathesis, as well as in terms of how best to describe the observed patterns within a formal model of phonology. This paper,

² I am grateful to David Odden for reminding me of this point.

therefore, takes as a starting point the view that a more comprehensive understanding of metathesis can be attained by investigating both formal and functional aspects of the process. To this end, I focus in section 2 on the potential influence on metathesis of factors external to phonology, including perception, production, cognition, and society. As a means of situating this discussion within a broader context, section 2 briefly lays out relevant assumptions concerning the interplay of external factors and phonology, in general. In section 3 I shift my focus to the characterization of metathesis within phonological theory. In particular, I present a sketch of a formal theory of metathesis within Optimality Theory. Conclusions appear in section 4.

2. External Influences on Metathesis

2.1 Background

As discussed in Hume & Johnson (2001), phonology is broadly defined to include both the cognitive representation of a language's sound structure as embodied in speakers' brains, characterized as p in figure 1, as well as formal phonological theory. We may assume that p is a component of l , the cognitive symbolic representation of a language. The linguistic sound system of a community of speakers/listeners can thus be defined as a collection of p 's. The formal symbolic domain defines the inventory of symbols and the procedures for symbol manipulation found in formal linguistic descriptions. The theory describes sound patterns observed in language, hence, the arrow pointing from p to *Formal Phonological Theory* in figure 1. It is these sound patterns that constitute the data that the theory is based on. The arrow pointing from *Formal Phonological Theory* to p reflects the goal of phonological theory to predict possible grammars. A formal symbolic description is not the same as a cognitive symbolic representation. Nonetheless, formal descriptions that remain consistent with what is known about cognitive representation provide insight into the cognitive representation by providing a language for discussing the intricacies of the mind.

The relationship between external factors and the two symbolic domains is also illustrated in figure 1. Two familiar low-level effects in the model, *perception* and *production*, have been discussed for decades in functional accounts of sound patterns. The role of 'ease of perception' and 'ease of production' are widely cited, though specific proposals as to how they may influence language are rare. Also included in the model are two higher level effects,

generalization and *conformity*. Generalization refers to the tendency to simplify cognitive representations relative to the sensory reality experienced. This tendency for generalization underlies category formation in cognitive systems generally, and we see it as related to linguistic processes such as paradigm leveling and analogy. Conformity relates to the social and communicative factors which play an important role in shaping language sound structure. From a social perspective, the need to conform to a linguistic norm, for example, can exert influence over an individual's cognitive language sound patterns. The need in a communicative system to use forms that others will identify and accept also influences sound systems.

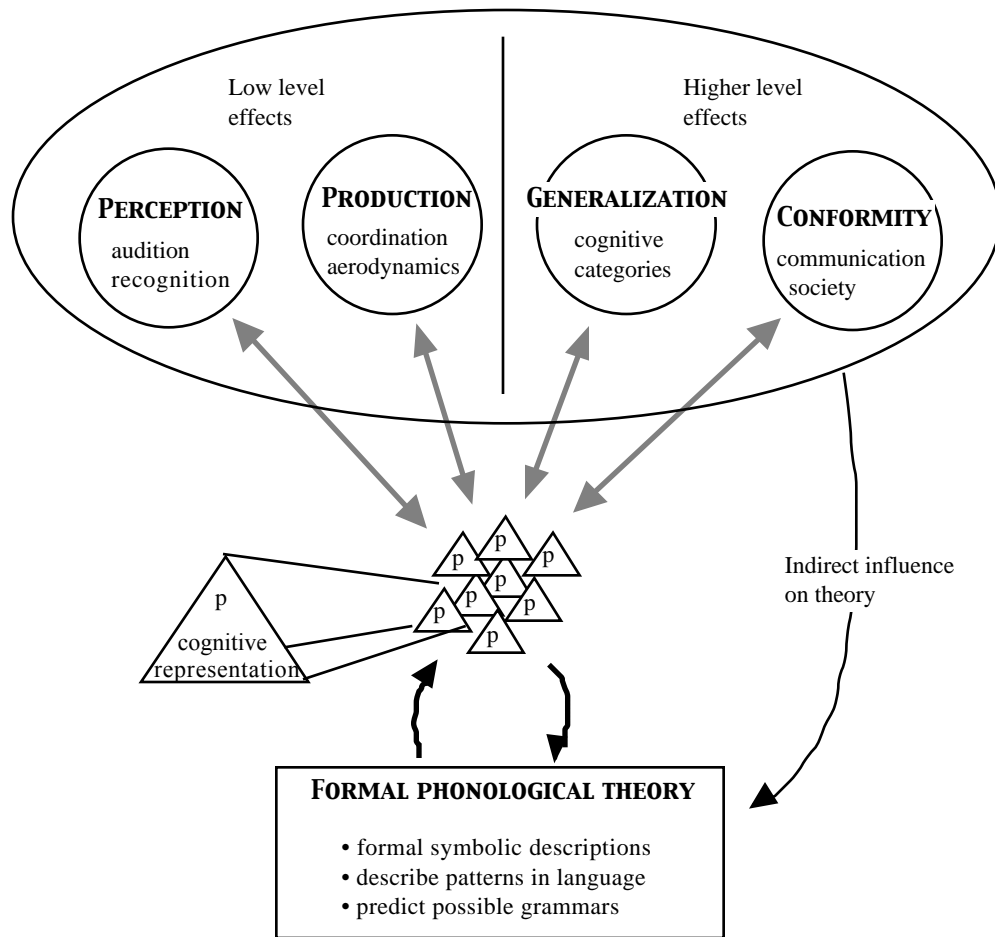


Figure 1. A general model of the interplay of external forces and phonology, broadly defined.

In our view, cognitive language sound patterns (p) are directly influenced by these external forces. However, the connection between formal phonological theory and the external forces is indirect (for an alternative view see, e.g., Flemming 1995, Steriade 2001). The formal theory describes patterns found in individual languages and from these, derives cross-linguistic generalizations about those patterns. To the extent that language sound patterns are caused by external factors such as speech perception, these factors are reflected in the formal phonological theory. Yet, to incorporate them directly into phonological theory erroneously implies that they are exclusive to language. On the contrary, the cognitive factor, generalization, for example, relates not only to linguistic category formation, but to category formation in general. Similarly, speech perception uses perceptual abilities that are also relevant to general auditory and visual perception (Fowler 1986). We refer the reader to Hale & Reiss (2000) for related discussion.

We view the model outlined in figure 1 as a starting point for the study of the interplay of external forces and phonology, broadly defined. Each aspect of the model constitutes an important area of research which, together, will lead to a more comprehensive understanding of language sound structures. With this as a basis, consider how each of the four external forces may have an impact on metathesis patterns.

2.2 Perception

That speech perception influences metathesis patterns is evidenced by considerations from, for example, word recognition and perceptual optimization. Mielke & Hume (2001) draw on evidence from word position and adjacency to show the effects of word recognition on metathesis. With respect to word position, it has been claimed that the left edge of the root or word is special for word recognition (Beckman, 1998; Cutler et al., 1985; Halle, 1992; Marslen-Wilson, 1989; Marslen-Wilson & Zwitserlood, 1989) since lexical access is generally achieved on the basis of the initial part of the word. Hence, salient information tends to occur at the beginnings of words, and this location tends to resist phonological processes (Hall 1992). Observed patterns of metathesis are consistent with this overall pattern: only 7.4% of observed cases of synchronic metathesis involve segments at the left edge of the word or root. The observation that all regular cases of synchronic metathesis involve adjacent segments may also show the influence of word recognition considerations; long-distance segment switching may not

yield successful recovery of the intended word, at least not easily, whereas adjacent segment switching may do so more of the time (Mark Pitt, p.c).³

Perceptual optimization may also play a key role in shaping patterns of metathesis. As discussed in Hume (1998b, 2000), metathesis frequently occurs in contexts of low salience and serves to enhance the contrast of the sounds in that context. Thus, the metathesized form is superior to the expected unmetathesized form in terms of the overall perceptual salience of the segments involved. This can be achieved by shifting a consonant from an environment in which its acoustic cues are obscured to one in which the cues to its identification are more robust, or by reordering segments in order to improve the overall salience of a neighbouring sound or sounds. The end result of both strategies is the perceptual optimization of the sequence as a whole.⁴ (For related discussion see Grammont 1939, Makashay 2001, Steriade 2001, Winters 2001). Examples of metathesis in Lithuanian and Kui serve to illustrate.

In the case of Lithuanian, a coronal fricative (s, z, š, ž) is reordered after a velar stop if a consonant follows the stop, as shown in (2). (See Seo & Hume 2001, for detailed discussion.) As can be seen in the 3rd past, the order fricative/stop occurs when the stop consonant is followed by a vowel. However, when a consonant follows, the stop consonant appears before the fricative.

(2)	<i>3 past</i>	<i>imper. sg.</i>	<i>infinitive</i>	<i>agent noun</i>	<i>gloss</i>
	mezg-a	meks-k	meks-ti	megz-li:s	knit
	urzg-e	urks-k	urks-ti	urgz-li:s	grumble

According to Seo & Hume (2001), metathesis in Lithuanian repairs the ill-formed sequence of a stop sandwiched between two consonants, as in the unmetathesized form of the infinitive, e.g. *mesk-ti. This context can be considered particularly poor for the identification of the stop's place and manner of articulation due to the absence of vowel formant transitions, the potential absence of a release burst, and the masking of phonetic cues by adjacent consonants. By

³ Of course, constraints on word recognition are not the only factors that could impact adjacency. Phonetic considerations surely also play a role. For example, many cases of consonant/consonant metathesis are perceptually motivated, affecting sounds in perceptually poor contexts (Hume 1998b, 2000); what often contributes to poor perceptibility is the adjacency of one consonant to another acoustically similar consonant.

⁴ This account differs significantly from that proposed by Blevins & Garrett (1998) for diachronic C/V metathesis. They assume that the order of segments in the output is random. Conversely, it is assumed here that when you take into account the nature of the metathesizing segments, the relevant contextual and internal perceptual cues of the

metathesis, the order of the fricative and stop is reversed, allowing the stop to occur in a more optimal context, that is, after a vowel. Not only is the perceptibility of the stop improved in this new position but, in addition, contrast among sounds in the sequence is enhanced. The gain in perceptibility achieved by realizing the stop in postvocalic position outweighs any potential loss incurred by shifting the fricative to inter-consonantal position.

A similar strategy is employed in Kui, a language with metathesis involving segments that are acoustically/auditorily similar; only a place feature distinguishes the labial and velar stop consonants involved. In the conjugation of verbs, the present participle and infinitive is typically formed by the addition of the suffixes /-pi/ and /-pa/, respectively, as shown in (3a). However, just in case the stem ends in a velar stop, the suffix-initial labial stop occurs to the left of the stem-final consonant (Winfield 1928). Note that stress falls on the root and, as a result, [p/b] occur in the coda of the stressed syllable, e.g. [blúpka] 'to break down'.

(3)	<i>Verb Stem</i>	<i>Future</i>	<i>Past</i>	<i>Pres.Part.</i>	<i>Infinitive</i>	
a.	ah-	ahi	ahte	ahpi	ahpa	'to hold'
	gas-	gasi	gaste	gaspi	gaspa	'to hang oneself'
	sap-	sapi	sapte	sappi	sappa	[no gloss given]
	uṭ-	uṭi	uṭte	uṭpi	uṭpa	'to give to drink'
b.	bluk-	bluki	blukte	blupki	blupka	'to break down'
	mlik-	mliki	mlikte	mliпки	mliпка	'to turn over'
	lek-	leki	lekte	lepki	lepka	'to break'
	nog-	nogi	nogde	nobgi	nobga	'to wash'
	ag-	agi	agde	abgi	abga	'to be fitting'

An experimental study of the salience of consonant place in the context VCCV suggests that positioning a dorsal stop consonant in the onset, even when unstressed, provides a greater boost in perceptibility than it does for a labial stop consonant (Winters 2001). In this study, American English listeners showed greater sensitivity (calculated using the signal detection measure *d'*) to both labial and dorsal place in unstressed prevocalic (onset) position than in stressed postvocalic (coda) position. However, the difference in sensitivity between coda and onset position was greater for the dorsal than for the labial, as shown in figure 2.

To the extent that these results can be taken as representative of a cross-linguistic pattern, they suggest that the shift of the dorsal consonant in Kui to prevocalic position gives it a

segments, and the role of contrast in the language, the order of sounds emerging as the result of metathesis is not

significant gain in salience. The result is that the two consonants occur in the contexts which maximize their individual salience as well as the overall salience of the pair. Thus, contrast is strengthened along both syntagmatic and paradigmatic dimensions.

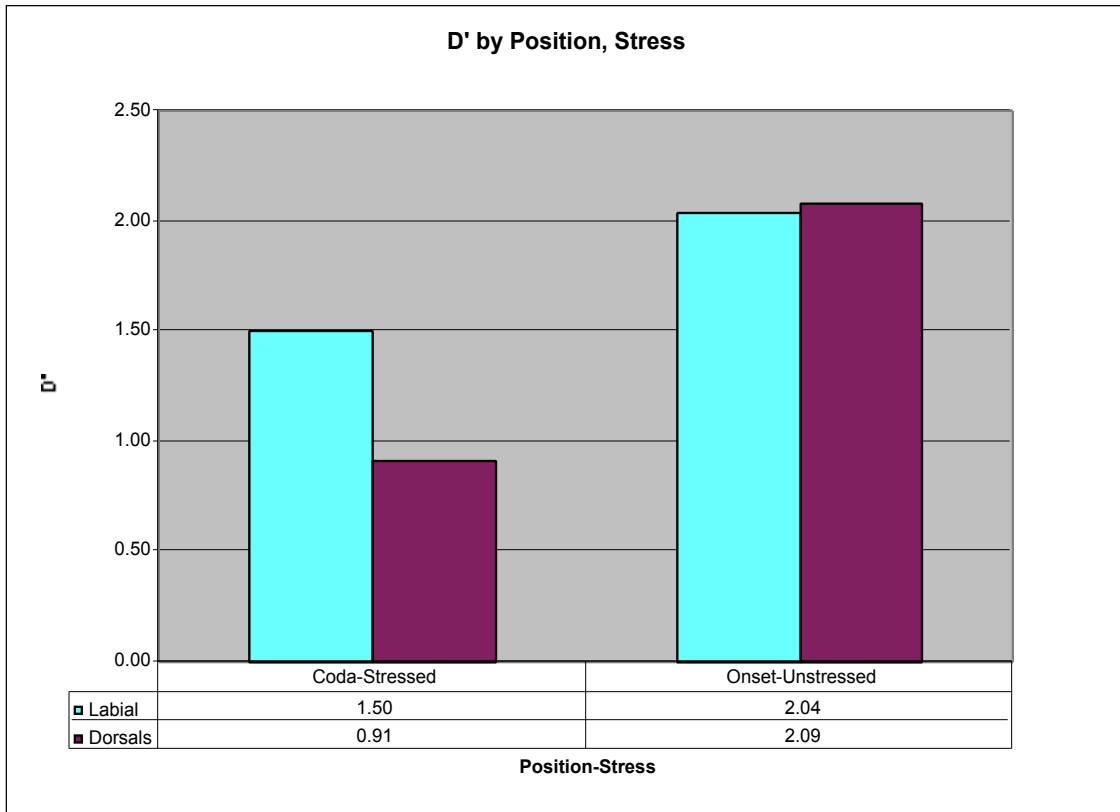


Figure 2. Relative perceptual salience, calculated as a measure of d' , of labial (leftmost bar in pair) and dorsal (rightmost bar in pair) stop consonants in stressed coda vs. unstressed onset position (Winters 2001).

2.3 Articulation

Articulatory considerations may also influence patterns of metathesis (Grammont 1939, Hume 1997). An apt example comes from Deg, a Gur language of west-central Ghana (Crouch 1994). As discussed in Hume (1997), articulatory timing plays a key role in the organization of heterorganic consonants in clusters in the language. Specifically, the articulation of the first consonant is systematically posterior to that of the second, as shown in (4).⁵

random. Rather, the perception of the sequence as a whole is enhanced by metathesis.

⁵ The inventory of consonantal phonemes in Deg is made up of the following sounds (Crouch 1994): p p^W b b^W t t^W d d^W tʃ tʃ^W dʒ dʒ^W k k^W g g^W kp bg f v s s^W h h^W m m^W n N ŋ ŋ^W l l^W r w y.

(4)	<i>Permissible clusters:</i>	<i>Impermissible clusters:</i>
	dorsal + coronal	*coronal + dorsal
	dorsal + labial	*labial + coronal
	coronal + labial	*labial + dorsal

Metathesis in Deg applies as a strategy to repair consonant sequences not conforming to this language-wide generalization. The process involves the labial sonorants /m,w/ when followed by /r/. As illustrated in (5.a), the formation of the plural of class 1 nouns typically involves the addition of the suffix /rV/ (vowel quality differences are attributable to vowel harmony). Similarly, as shown in (c), the plural of Deg verbs can be formed by the addition of a suffix /-rV/ (note that the final vowel of the verb stem is deleted before the suffix). However, when the stem ends in /m/ or /w/, as in (b, d), metathesis occurs.⁶

(5)	<i>Singular</i>	<i>Plural</i>	
a.	[p ^w e]	[p ^w eri]	‘floor pounder’
	[dʒo]	[dʒori]	‘net’
	[dʌgu]	[dʌguri]	‘grasscutter’
	[Naŋ] ⁷	[Naŋ ^o ri]	‘back’
b.	[nɔm]	[nɔ ^o mi]	‘scorpion’
	[dem]	[de ^o mi]	‘house’
	[nam]	[na ^o mi]	‘type of tree’
	[dom]	[do ^o mi]	‘sleep’
c.	[vugɛ]	[vug ^o ri]	‘to divine [many times]’
	[niɔ]	[niɔ ^o ri]	‘to deceive’
d.	[siwɛ]	[si ^o wi]	‘to die’
	[lawɛ]	[la ^o wi]	‘to catch’
	[ume]	[u ^o mi]	‘to clench fist’

With regards to the data in (5), it is significant that while a dorsal consonant may precede a coronal, a labial consonant may not. Instead, metathesis occurs as a means of conforming to the posterior-anterior ordering noted above. This supports Grammont’s (1939) claim that the linear ordering of two consonants may change so that the more posterior articulation precedes the more

⁶ The scope of metathesis in Deg is limited for a number of reasons. First, obstruents other than /g/ do not regularly occur in stem-final position. Second, the coronal sonorants [n, l] never occur in a cluster with [r]. Finally, few suffixes are consonant-initial and, as a result, the range of contexts which could potentially favor metathesis is restricted. With the exception of the /rV/ suffix noted above, the only other consonant-initial suffixes mentioned in Crouch’s work are the plural suffix /-nV/, which generally occurs only after vowel-final noun stems, and the pronoun objects /mɛ/ and /ba/.

⁷ N represents an alveo-palatal nasal.

anterior one. Metathesis in Deg is significant as it provides synchronic evidence for this view, previously only exemplified by cases from dialectal variation and child language.

The sequencing of consonants whereby the articulation of the first consonant is posterior to that of the second may have an explanation in the aerodynamics of egressive airflow. For sequences involving stops and fricatives, ordering the articulations in a manner consistent with the direction of airflow may provide greater air pressure for the production of the release bursts in stops, and for sustained turbulence in the case of fricatives. The motivation is less apparent in the case of fricatives and sonorant consonants, sounds for which a release burst is of lesser importance or entirely lacking. Pattern congruity may be of relevance in this respect, however (see e.g. Maddieson 1984 and related discussion just below). If a language makes use of a posterior-anterior ordering for a subset of consonants, it is reasonable to assume that the more economical language would be one in which this ordering is used for other sequences as well, even if they do not have similar aerodynamic requirements.⁸

3.3 Generalization

Generalization refers to the tendency to simplify cognitive representations relative to the sensory reality experienced. This tendency for generalization underlies category formation in cognitive systems generally, and may be related to linguistic processes such as paradigm leveling and analogy. One example of how this cognitive factor may play a role in shaping metathesis processes was alluded to just above regarding the posterior-anterior ordering of articulations in consonant clusters in Deg. Another illustration comes from a comparison of metathesis in Lithuanian, seen above, and Faroese. Although the patterns of metathesis in the two languages

⁸ In this regard, it may be of significance that the articulations of all complex segments in Deg are produced in the order posterior-anterior. In the case of labiovelar stops [kp, gb], Connell (1994), Ladefoged & Maddieson (1996) and Maddieson (1993) show that the dorsal closure generally precedes the labial closure. Similarly, in the case of labialized consonants such as [s^W, l^W, k^W], while the articulations in such segments are assumed to be simultaneous phonologically, in terms of their phonetic realization, a secondary labial articulation is realized during the consonant's release phase, hence, following the primary consonantal articulation. Consequently, for labialized coronals and dorsals, the articulatory timing of posterior-anterior is once again observed. This same observation may be extended to the labialized glottal [h^W] in Deg. Under the assumption that the primary constriction of the glottal occurs at the level of the larynx, the ordering of the constriction for [h^W] also follows the posterior-anterior pattern observed for labialized coronal and dorsal consonants. Thus, given the potential aerodynamic benefits of the order posterior-anterior for stops and fricatives, in addition to the observation that the language also contains multiply-articulated segments for which similar timing considerations hold, generalizing the posterior-anterior ordering requirement to all sequences of consonants in the language may result in a simpler and potentially more learnable language.

appear almost identical at first glance, upon closer examination a number of significant differences emerge. In fact, as Seo & Hume (2001) show, Lithuanian metathesis is basically a simpler, more generalized version of the pattern observed in Faroese.

In both Faroese and Lithuanian, metathesis occurs across a morpheme boundary, and involves a velar stop and coronal fricative. As shown in (6) for Faroese, the sequence [sk] can be observed at the end of the feminine singular form of adjectives (Lockwood 1955, Jacobsen & Matras 1961, Rischel 1972, H. Petersen, p.c.). The sounds also occur in this order in the masculine singular form, followed by a vowel-initial suffix. However, in the neuter singular form of adjectives, the segments surface instead in the order [ks]. The same pattern can be seen in verbs.

(6)	<i>Faroese:</i>	<i>fem. sg.</i>	<i>masc. sg.</i>	<i>neut. sg.</i>	<i>Gloss</i>
		baisk	baiskor	baikst	‘bitter’
		fesk	feskor	fekst	‘fresh’

A similar pattern is found in Lithuanian (Kenstowicz 1972, Ambrazas 1997, Seo & Hume 2001). As shown in (7), Lithuanian differs from Faroese in that any coronal fricative can undergo metathesis. The pattern can be seen, for example, by comparing the third person singular past imperfective verb forms with those of the imperative and infinitive. In the former, the order fricative + stop emerges while in the latter, the order is reversed, giving stop + fricative.

(7)	<i>Lithuanian:</i>				<i>Gloss</i>
	<i>3sg. past imperf.</i>	<i>imper. sg.</i>	<i>infin.</i>		
	pl ^ʎ eske	pl ^ʎ eksk	pl ^ʎ eksti		‘flash intensely’
	breško	breškš	brekšti		‘break (of dawn)’
	brizgo	briksk	briksti		‘fray’

While the segments involved in metathesis are similar in the two languages, there are differences when it comes to the contexts in which the process occurs. With respect to the following segment, metathesis is observed in Faroese only when the sequence /sk/ comes before a stop consonant, as shown in (8). All examples with metathesis show the following stop to be coronal due to the fact that there are no suffix-initial stop consonants at other places of articulation in the language.

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(8) <i>Faroese:</i>	<i>fem. sg.</i>	<i>masc. sg.</i>	<i>neut. sg.</i>	<i>gloss</i>	
	tɔsk	tɔskor	tɔkst	‘German’	*tɔskt
	nask	naskor	nakst	‘impertinent’	*naskt
	cf. vask / vask *vakss ‘sink: nom./gen.sg’				

In Lithuanian, any following consonant triggers metathesis. Examples in (9) illustrate metathesis occurring in the context of a following stop, fricative and liquid.

(9) <i>Lithuanian:</i>					
___ <i>stop</i>	bloške	blokšk	blokšti	‘toss, 3sg. past; imper. sg.; infin.’	
___ <i>fric.</i>	triško	trikšta (<trišk-sta) ⁹		‘sprout, 3sg. pres.; past’	
___ <i>liquid</i>	čirkš ^ə a	čirkšli:s		‘chirp, 3 sg. pres.; agent noun’	

Consider now the context preceding the metathesizing segments. In Faroese, metathesis occurs when the preceding segment is a vowel or nasal, as shown in (10a). Metathesis fails to apply in Faroese when the preceding segment is a liquid. Instead, the medial stop deletes, as in (b).

(10) <i>Faroese:</i>	<i>a. masc. sg.</i>	<i>neut. sg.</i>	<i>gloss</i>	
	baiskor	baikst	‘bitter’	
	franskor	fraŋ(k)st	‘French’	
	spanskor	sparaŋ(k)st	‘Spanish’	
	<i>b. falskor</i>	falst	‘false’	*falskt, *falkst
	nørskor	nørst	‘Norwegian’	*nørskt, *nørkst

In Lithuanian, on the other hand, the context preceding the fricative/stop sequence can be generalized to any sonorant.¹⁰ This was seen in (7) with a preceding vowel and is shown in (11) with a preceding liquid.¹¹

(11) <i>Lithuanian:</i>	<i>3sg. past imperf.</i>	<i>imper. sg.</i>	<i>infin.</i>	<i>gloss</i>
	n ^ə urzge	n ^ə urksk	n ^ə urksti	‘to growl’
	urzge	urksk	urksti	‘to grumble’

The role of stress in metathesis also differs in the two languages. On the one hand, in Faroese, the context for metathesis is conditioned by stress, which typically falls on the initial (or

⁹ Adjacent sibilants are simplified to a single palato-alveolar fricative by an independent process in the language.

¹⁰ While there are no alternations showing metathesis with a preceding nasal, all surface sequences with a preceding nasal reveal the expected order of segments, consistent with that observed for other preceding sonorants where metathesis has occurred; that is, Vŋ(k)[fric]C, (*Vn[fric]kC), e.g. bruŋ(g)zge, bruŋ(k)sk ‘grinding stone, 3sg.past, imperf./imper.sg.’.

¹¹ No words could be found with a preceding [l].

only) syllable of a word. The sequence /sk/ is only realized as [ks] if the preceding vowel is stressed, as shown in (12a). In words with a preceding unstressed vowel, metathesis fails to apply. Instead, the medial stop deletes, as in (b).

(12) *Faroese*:

	<i>masc. sg</i>	<i>neut. sg.</i>	<i>gloss</i>	
a.	ráskor	rákst	‘energetic’	*ráskt, *rást
b.	fø:risk	fø:ríst	‘Faroese’	*fø:rískt, *fø:ríkst
	rós:isk	rós:íst	‘Russian’	*rós:ískt, *rós:íkst

In Lithuanian, on the other hand, stress plays no role in the process. Metathesis applies regardless of whether the adjacent context is stressed or unstressed, e.g. *mėzge*, *mėksti*, *megzlís* ‘knit, 3sg. past perf./infin./agent noun’.

Table 1 provides a summary of the relevant observations concerning metathesis in the two languages. What emerges from this brief overview is the observation that while on the surface metathesis in the two languages appears quite similar, it is clear that by upon closer examination, the pattern in Lithuanian is essentially a simplified, more general version of the one in Faroese.

Table 1. Metathesis in Faroese and Lithuanian

Faroese	Lithuanian
a. [sk] ~ [ks]	a. [coronal fricative] + [k] ~ [k] + [coronal fricative]
b. Following context: before a stop	b. Following context: before any consonant
c. Preceding context: after a vowel or nasal (nasal assimilates to stop), not after a liquid (stop deletes)	c. Preceding context: after a sonorant
d. Stress: only when preceding vowel is stressed.	d. Stress: not relevant

3.4 Social factors

Social and communicative factors also play an important role in shaping language sound structure, as work in the field of sociolinguistics has made abundantly clear (see, e.g., Labov 1980). From a social perspective, the need to conform to a linguistic norm, for example, can exert influence over an individual’s cognitive language sound patterns. The need in a communicative system to use forms that others will identify and accept also influences sound systems. Thus, the extent to which a particular sound process spreads throughout a language, or

is maintained at all, is influenced by communicative factors. An interesting case in point involves metathesis in Old Spanish where metathesis actually loses out to another sound process.

Metathesis in Old Spanish was conditioned by vowel syncope in the future and conditional formation of the verb, resulting in the contiguity of /nr/. As shown in (13), two strategies were employed in the language to avoid the ill-formed /nr/ sequence: metathesis and intrusive stop insertion (examples are given for future forms of the verb although similar observations hold for the conditional). The two alternatives co-existed in all forms of the future and conditional. The variant with the intrusive consonant has survived in Modern Spanish while the forms with metathesis have not (Martínez-Gil, p.c.; Wanner, 1989).

(13)	<i>Infinitive</i>	<i>Future (1st p. sing.)</i>			
	poner	porné, pondré	(> pondré)	*[ponre]	'to put'
	tener	terné, tendré	(>tendré)	*[tenre]	'to have'
	venir	verné, vendré	(>vendré)	*[venre]	'to come'

The preference for the intrusive stop variant over the metathesis variant may have its roots in both perception and social factors. This explanation reflects the view of speech perception as a type of filter on sound change. In this approach, perception exerts influence on phonological systems by the avoidance of noticeable alternations (see, e.g. Hura et al.; Kohler 1990; Steriade 2001; and related discussion in Hume & Johnson, 2001). Note that the filter has two aspects, the first purely in terms of perceptual salience and the second in terms of the communicative context. As Steriade points out: "innovation is channeled...in the direction that is least likely to yield blatant departures from the [established pronunciation] norm." It is reasonable to speculate that metathesis in Old Spanish created a more noticeable sound change than the one resulting from intrusive stop formation. The metathesis variant thus diverged more perceptually from related members of the verbal paradigm lacking metathesis (the pronunciation norm) and, as a result, was ultimately rejected by the speech community and lost completely from the language.

3. Towards a Theory of Synchronic Metathesis

I turn in this final section to a consideration of how the process of metathesis fits into a general theory of phonological structure. As noted in the Introduction, one of the difficulties in formalizing metathesis has stemmed from its apparently distinct nature: unlike most

phonological processes, it appears to involve two targets. How then is this expressed formally? As I outline just below, Correspondence Theory (CT), an offspring of Optimality Theory (OT), provides a promising approach to the formal description of metathesis since not only are segment reversals possible between an input and output in the theory, they are in fact predicted to exist (Prince & Smolensky 1993, McCarthy & Prince 1993; but especially McCarthy & Prince 1999, McCarthy 2000). As in OT, in Correspondence Theory a given surface form is derived from an input by means of a universal set of ranked constraints, rather than rules (see e.g. Prince & Smolensky, 1993; McCarthy & Prince, 1993; McCarthy & Prince, 1995). In CT, however, greater emphasis is placed on relations between input and output elements. As a means of formalizing these relations, families of constraints have been introduced which penalize lack of faithfulness between input and output.

Among these constraints is LINEARITY, given in (14) (McCarthy, 2000; McCarthy & Prince, 1999) which penalizes the reversal of precedence relations among segments in a string (S). As such, forms displaying metathesis incur a violation of LINEARITY.

- (14) **Linearity:** "No Metathesis" (McCarthy & Prince, 1999)
 S₁ is consistent with the precedence structure of S₂, and vice versa.

As McCarthy 2000 shows, the subordination of LINEARITY to other constraints forces a change in the linear ordering of segments, hence, metathesis. Thus, like all constraints, LINEARITY may be violated as a means of satisfying other more highly-ranked constraints. For example, following Steriade (1997), Hume (1998b, 2000) draws on contextual constraints, as in (15), to capture the observation that segments involved in metathesis frequently occur in contexts of low salience.

- (15) **Avoid X/Y (*x/y):** avoid positioning segment X in context Y.

Avoid X/Y represents a family of constraints comprised of all segments in all observed contexts. Independent evidence for contextual constraints comes from asymmetrical patterns of dissimilation in Greek (Tserdanelis 2001) and /h/-deletion in Turkish (Ovcharova 1999, Mielke 2001).

(16) Avoid X/Y >> Linearity = metathesis.

		/VtsV/	*[stop]/__C	LINEARITY
	a.	VtsV	*!	
☞	b.	VstV		*

Of course, like all constraints, contextual constraints may be ranked with respect to one another. For example, the ranking $*[\text{stop}]/__C \gg *[\text{fricative}]/__C$ captures the observation that it is worse for a stop to occur before a consonant than it is for a fricative to occur in this position. Such a ranking is shown to be relevant to the analysis of metathesis in Faroese and Lithuanian, for instance (see Seo & Hume 2001). Constraint rankings such as these are informed by our understanding of the salience of speech sounds (contextual and inherent factors) as reflected through language sound patterns. Although factors such as speech perception are external to the formal theory and description of a particular language, their influence can nonetheless be observed in the constraint rankings. The constraint rankings, just like the constraints, reflect the influence of external factors on sound systems without being explicitly included in the theory.

Notice that this formal account of metathesis accounts for the apparent distinct nature of the process quite simply. That is, while metathesis, by definition, involves two segments, only one is crucially involved as the target in the formalism. This brings metathesis in line with other processes such as assimilation and deletion where only a single sound is identified as the target of the process.

In the remainder of this paper, I briefly discuss two additional observations concerning patterns of metathesis. The first involves the observation that regular metathesis systematically involves adjacent sounds and second, that multiple contextual conditions are frequently relevant in predicting metathesis.

Regular cases of metathesis involve strictly adjacent sounds (Mielke & Hume 2001). Given this, it is necessary to consider what, in phonological theory, prevents non-adjacent segments from switching positions with each other. What rules out unattested metatheses in which two consonants metathesize over any number of consonants and vowels, as in hypothetical /tob + nal/ [tolnab]? More generally, how do we account for the observation that minimal changes in the ordering of segments are always preferred, all else being equal?

Following Hume (1998a), this latter observation is accounted for straightforwardly by assuming that violations of the constraint LINEARITY are gradiently evaluated. This is illustrated

with three candidates in (17). In the first, the ordering of segments is entirely faithful to that of the input yet since the candidate violates high ranking constraint C, it is ruled out. Constraint C is satisfied in candidate (b) by reordering the final vowel and consonant, thus incurring a violation of LINEARITY. Candidate (c) also satisfies constraint C but does so by reordering the two consonants in addition to the final C/V. This added metathesis necessarily incurs one more violation of LINEARITY. As it stands, candidate (b) emerges as the winner since it has fewer violations of the constraint LINEARITY. Unless there is motivation for an additional reordering, the candidate with minimal changes in the ordering of segments will always be preferred.

(17) *Gradient evaluation of LINEARITY*

		I: / u ₁ k ₂ a ₃ r ₄ /	C	Linearity
	a.	u ₁ k ₂ a ₃ r ₄	*!	
☞	b.	u ₁ k ₂ r ₄ a ₃		*
	c.	u ₁ r ₄ k ₂ a ₃		**!

Under the assumptions that first, LINEARITY violations are gradiently evaluated and second, metathesis only occurs when there is motivation for change, we predict a language in which the optimal output may incur more than a single violation of LINEARITY; that is, multiple instances of metathesis within a single word.

Metathesis in Fur, a Biltine language, serves to illustrate. Metathesis is triggered by the addition of one of several person prefixes which consist of a single consonant. As shown in (18), when a consonantal prefix (such as k- ‘we’) is affixed to certain consonant-initial verbs, the initial consonant of the verb metathesizes with the following vowel since the prefix and the initial consonant do not form a permissible word-initial cluster. Jakobi (1986) lists 60 verbs with this pattern.

- (18)
- | | | |
|---------|--------|----------------------|
| k+ba- | kab- | ‘we drink’ |
| k+saar- | kasar- | ‘we expose for sale’ |
| k+lat- | kald- | ‘we beat, hit’ |

There are also words in which the consonant appears to metathesize not only with the vowel, as in (18), but also with the following consonant, as shown in (19). (Note that /b/ in the input is realized as [m] as a result of an independent process.)

- (19)
- | | | |
|-------|------|--------|
| k+bul | kulm | ‘find’ |
|-------|------|--------|

While [b/m] appears to undergo non-adjacent metathesis by skipping two segments, Mielke & Hume argue that two instances of adjacent metathesis are actually involved. The first is C/V metathesis which breaks apart a consonant cluster created by morpheme concatenation, as in (20a). This step is observed both with and without an additional CC step, as in (b), which metathesizes two consonants when the first metathesis results in an impermissible sequence of consonants.

- (20) a. k+ba kab ‘we drink’
 b. k+bul kuml kulm ‘we find’

Both patterns receive a straightforward account given the assumption that violations of LINEARITY are evaluated gradiently. Consider first the change from /k+ba/ [kab], shown in (21). We may assume that this type of C/V metathesis is motivated by a phonological constraint C₁ (e.g. a prohibition against initial clusters) which is crucially ranked above LINEARITY. As a result, candidate (a) fails, allowing the metathesis candidate in (b) to be selected.

- (21) *Fur metathesis*

		I: k + ba	C ₁	Linearity
	a.	kba	*!	
☞	b.	kab		*

However, this constraint ranking is unable to account for words which also show C/C metathesis, such as /k+bul/ [kulm]. (For simplicity, I ignore the additional process of sonorant assimilation which causes the change from /b/ [m].) An additional constraint, C₂, is required to rule out the candidate with only C/V metathesis in (22b). Candidate (c) satisfies the second phonological constraint by including a second metathesis, yet, by doing so, incurs a further violation of LINEARITY. Nonetheless, despite two violations of LINEARITY, candidate (c) emerges as the correct surface form.

- (22) *Fur metathesis*

		I: k + bul	C ₁	C ₂	Linearity
	a.	kmul	*!		
	b.	kuml		*!	*
☞	c.	kulm			**

To my knowledge, there are no cases of metathesis involving more than two violations of LINEARITY. For example, cases in which a complete array of segments within a word are rearranged are not attested. This is perhaps not surprising since drastic reorderings would surely inhibit word recognition (for related discussion, see Hume 1998a, Mielke & Hume 2001).

A final point addressed in this paper concerns the observation that more than one condition frequently contributes to the conditioning environment for metathesis, as the following examples illustrate.

- (23) a. In Faroese metathesis the velar stop must be adjacent to another stop and be flanked by two consonants, e.g. /fesk-t/ [fɛkst].
 b. In Modern Hebrew, the coronal stop must be adjacent to a coronal sibilant and it must be preconsonantal, e.g. /hi+t+zaken/ [hizdaken] ‘he grew old’.
 c. In Rendille, the pharyngeal fricative must be adjacent to the pharyngeal vowel /a/ and the consonant must be in preconsonantal position, e.g. [baħab], [babħ-o] *[baħbo] ‘armpit, sing./plur.’; [aħam], [amħ-a] *[aħma] ‘eat!, sing./plur.’; [yaħar], [yarħ-a] *[yahra] ‘cough!, sing./plur.’.
 i. The pharyngeal may occur preconsonantly provided that it is not preceded by a pharyngeal vowel, e.g. [liħti] *[liħti] ‘rock’, cf. /baħb+o/ [babħo] *[baħbo] ‘armpit, pl.’
 ii. It may occur adjacent to /a/ provided that it does not occur preconsonantly, e.g. [nabaħ] ‘ear’, [amħa] ‘eat! plur.’.
 iii. For metathesis to occur, two conditions (contextual constraints) must be violated: *phar/V__C and *[phar]/[phar]__.

Drawing on Crowhurst and Hewitt (1997), we may account for such patterns by means of macro-constraints, comprised of two independent constraints, as illustrated by the relevant constraint for Rendille in (24) (see also, e.g. Smolensky (1997), Alderete (1997) on *local conjunction*). Following Crowhurst and Hewitt, a macro-constraint necessarily requires each coordinated constraint to share a common focus, which in this case is [pharyngeal]. A candidate passes a macro-constraint if it satisfies either of the coordinated constraints.

- (24) Macro-constraint: *phar/V__C V^{phar} *[phar]/[phar]

The Rendille forms in tableau (25) serve to illustrate.

(25) Macro-constraint for Rendille: *phar/v__c v *[phar]/[phar]__

i.		I: baḥab-o	*phar/V__C	<i>v^{phar}</i>	*[phar]/[phar]	LINEARITY
	a.	baḥbo	(*)	*!	(*)	
	☞ b.	babḥo				*
ii.		I: aḥam-a				
	c.	aḥma	(*)	*!	(*)	
	☞ d.	amḥa			(*)	*
iii.		I: liḥti				
	☞ e.	liḥti	(*)			
	f.	liḥi				*!
iv.		I: nabaḥ				
	☞ g.	nabaḥ			(*)	
	h.	nabḥa			(*)	*!

In the first word, the unmetathesized candidate in (a) violates both parts of the macro-constraint since the pharyngeal occurs preconsonantly and is adjacent to /a/. In the metathesized form in (b), both conditions are satisfied, with only lower ranking LINEARITY violated. A similar situation occurs in the second word. Note that although candidate (d) incurs an OCP violation, this alone is not sufficient to rule it out. It wins out over candidate (c) which fatally violates the macro-constraint. The observation that a pharyngeal can occur preconsonantly when not adjacent to /a/ is illustrated in the third example where the unmetathesized candidate in (e) wins. And finally, contiguity of the pharyngeal consonant to /a/ is insufficient to rule out either candidates (g) or (h). The correct output is determined by LINEARITY, violated in (h).

3.1 Summary

The preceding discussion suggests that the basic components of an OT theory of synchronic metathesis include at least the following:

- (26)
 - o Linearity: a violation means a mismatch between input/output ordering relations.
 - o Violations of Linearity are gradiently evaluated: all else being equal, minimal changes in the ordering of segments is preferred.
 - o A more highly ranked constraint C, e.g. Avoid X/Y, motivates metathesis by forcing a segment reordering (one of the segments involved in metathesis is crucially identified in the constraint).
 - o Linearity is ranked above other faithfulness constraints, i.e. metathesis is selected as the repair strategy used to satisfy C.
 - o Constraint co-ordination allows for the expression of multiple conditions on the input to metathesis.

4. Conclusion

As I hope to have shown in this paper, regular synchronic metathesis is attested in a wide range of languages cross-linguistically and conditioned by natural language constraints. By viewing metathesis in the context of the external factors that shape its patterns, we move closer to a fuller understanding of why and how metathesis occurs and, in turn, are able to better situate metathesis within the broader inventory of processes which shape phonological systems. To the extent that such investigations elucidate the observed patterns of metathesis, they also allow for a more accurate representation of metathesis within formal phonological theory.

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