Phonology **34** (2017). Supplementary materials

Moro voicelessness dissimilation and binary [voice]

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Supplementary materials

Appendix A: VOT measurements for Moro speakers

(a)

	voiceless initial		voiceless intervocalic			
	VOT	SD	closure	SD	VOT	SD
labial	17.91	8.96	140.77	18.16	26.24	7.92
dental	13.57	7.33	120.35	36.07	16.01	6.47
alveolar	21.63	9.32	142.61	39.28	20.17	9.76
velar	40.33	21.03	122.21	29.23	31.93	9.21

(b)

	voiced initial		voiced intervocalic	
	VOT	SD	closure/friction	SD
labial	−75.99	24.02	67.73	5.33
dental	−78.68	58.80	63.02	6.78
alveolar	−80.53	37.33	45.73	5.98
velar	−45.33	19.55	50.09	4.06

Table VI
Duration measurements (ms) for (a) voiceless stops and (b) voiced stops (speaker F1).

(a)

	voiceless initial		voiceless intervocalic			
	VOT	SD	closure	SD	VOT	SD
labial	24.60	4.61	123.04	30.72	22.39	5.50
dental	17.05	3.54	129.72	27.85	16.46	3.61
alveolar	18.18	6.19	123.83	17.80	15.42	2.09
velar	39.48	6.41	163.82	22.66	36.07	15.30

(b)

	voiced initial		voiced intervocalic	
	VOT	SD	closure/friction	SD
labial	−83.11	43.89	51.13	13.23
dental	−100.49	33.57	64.75	4.84
alveolar	−77.32	47.27	61.70	6.34
velar	−110.81	27.63	43.70	5.14

Table VII

Duration measurements (ms) for (a) voiceless stops and (b) voiced stops (speaker M1).

(a)

	voiceless initial		voiceless intervocalic			
	VOT	SD	closure	SD	VOT	SD
labial	18.84	5.23	139.94	9.13	18.35	6.57
dental	19.14	6.84	132.86	13.60	24.26	8.98
alveolar	14.28	2.53	137.15	12.61	13.45	2.04
velar	39.44	8.74	133.73	17.39	38.05	12.42

(b)

	voiced initial		voiced intervocalic	
	VOT	SD	closure/friction	SD
labial	−75.64	10.59	65.85	6.63
dental	−66.55	9.73	53.92	4.67
alveolar	−78.91	5.32	35.57	7.09
velar	−88.98	10.44	61.19	4.30

Table VIII

Duration measurements (ms) for (a) voiceless stops and (b) voiced stops (speaker M2).

Appendix B: Comparison to other accounts of dissimilation

The surface correspondence analysis we have developed is not necessarily the only way to analyse the Moro dissimilation pattern. In this appendix, we briefly compare our account to other treatments of dissimilation. Most notable among these is the OCP, which is construable in various ways. Our goal is not to disprove the OCP at a conceptual level – particularly since the viability of the idea depends very much on the specifics of how it is formalised. The surface correspondence approach we employ does have certain advantages over theories that posit the OCP as a formal phonological constraint. However, and more importantly, these alternative analyses must assume – as we do – that [−voice] is a real, phonologically active, feature. (We refer the reader to §1.3 and §3 of the paper for arguments against alternatives that try to handle voiceless dissimilation using other features, such as only privative [voice] or [+spread glottis].)

1 OCP accounts

Many previous treatments of dissimilation invoke some form of the Obligatory Contour Principle, to penalise the co-occurrence of similar segments (or other phonological units). Although originally formulated as a restriction on underlying representations (Leben 1973), the OCP was subsequently argued to block and trigger rules (McCarthy 1986, Yip 1988, etc.), and later reinterpreted as a violable surface constraint (Myers 1997, Suzuki 1998). Since the Moro dissimilation alternations are clearly not the result of a restriction on underlying forms, we take up only these latter conceptions of the OCP here.

In traditional autosegmental terms, the OCP was characterised as a prohibition against identical elements that are adjacent at the melodic level. In effect, then, it is a ban against two instances of the same feature, on the same tier. In order to obtain the voiceless dissimilation effects we observe in Moro, a traditionalist OCP account must assume that voiceless obstruents are represented with the feature [−voice], on a tier that abstracts away from the phonetically voiced quality of an intervening vowel. This presupposes [−voice] as a feature; an assumption shared with our surface correspondence approach. Also like our account, the transvocalic locality condition on dissimilation must be handled by additional machinery. Our SCTD analysis handles this by limiting the domain of Corr constraints; it is built into the mechanism that drives the dissimilation. In autosegmental terms, transvocalic locality cannot in principle be stated as a restriction on tiers; in order for two voiceless segments to be adjacent on the [±voice] tier, intervening sonorants must not be represented on that tier. As such, locality conditions must be stated separately (along the lines of Odden 1994, for instance).

More recent implementations of the OCP in Optimality Theory (Myers 1997, Suzuki 1998) tend to abstract away from autosegmental structure; for Suzuki's Generalised OCP (GOCP), in fact, no autosegmental representations are crucially assumed. Suzuki's approach handles locality in a fundamentally different way, by representing the OCP as a family of constraints that ban adjacent features within a specified proximity domain. By replacing the notion of an autosegmental tier with an explicit proximity parameter, the GOCP offers a straightforward way to handle transvocalic dissimilation like that in Moro: the relevant OCP constraint is *[−voice]-μ-[−voice], which can only assign violations to voiceless segments in a CVC configuration. In this kind of analysis, again, it is necessary to assume that [−voice] is active and represented, on the same order as [+voice], and other features.

Our surface correspondence analysis does have one notable advantage over OCP accounts like Suzuki's. GOCP constraints are strictly bans on feature co-occurrence: they are applicable only to dissimilation. Not so for surface correspondence. Bennett's (2015) SCTD builds on Agreement by Correspondence theory (Rose & Walker 2004, Hansson 2010) – a theory of consonant harmony. As such, it links assimilation and dissimilation together: a single set of constraints is responsible for both phenomena. For example, the Corr-CVC·[−voice, −cont] constraint that we posit here could also give rise to transvocalic harmony among voiceless stops. Such a pattern seems to exist in Lezgian (Kochetov & Ozburn 2014), where voiced stops that undergo pretonic devoicing agree in ejectivity with an ejective in the preceding syllable (e.g. /t'ab-uni/ → [t'ap'úni], *[t'apúni] 'lie (erg sg)'). By the same token, CC·Edge(root) can not only spur dissimilation, but can also serve to set the root as a domain that bounds harmony (see Bennett 2015 for discussion). Root-internal consonant harmony of the predicted sort is quite common in previous surveys (Rose & Walker 2004, Hansson 2010). This unification of harmony and dissimilation under the same theory hearkens back to work in autosegmental phonology that invoked the OCP to explain assimilation (Mester 1986, Yip 1988, etc.); connecting dissimilation to another phenomenon is as appealing now as it was then.

2 Dissimilation as markedness

Another approach to dissimilation aims to derive it from markedness. Like the SCTD, and earlier autosegmental work – and unlike anti-similarity formulations of the OCP – the markedness-driven approach connects dissimilation to something else in the grammar: prohibitions on the co-occurrence of similar segments are derived from more basic restrictions on the occurrence of those segments.

The proposal, made in very similar form by both Alderete (1997) and Itô & Mester (1998), takes OCP constraints to be self-conjunctions of basic markedness constraints. Thus, a constraint like OCP-labial is actually *Labial^2, a constraint that assigns violations for pairs of distinct violations of *Labial in the same local domain. Alderete's (1997: 28ff) analysis of labial dissimilation in Berber relies on just such a constraint, which assigns violations only for two instances of [labial] in the same stem. Itô & Mester (1998) pursue the same line of analysis for Lyman's Law in Japanese, where rendaku voicing fails in roots that contain another voiced obstruent.

Markedness-based accounts like these predict that only marked feature values can dissimilate. This follows from deriving OCP-like constraints from self-conjunction of markedness constraints of the form $*[\alpha F]$; if Con includes $*[\alpha F]^2$, it must also include $*[\alpha F]$. The consequence of such an analysis of Moro is that positing a constraint $*[-\text{voice}]^2$ entails the existence of *[−voice]. In other words, voiceless obstruents must actually *be marked*. This is incompatible with theories in which markedness constraints only target the marked values of features, such as that of de Lacy (2006). In de Lacy's approach, [+voice] is the marked value of voicing; as such, there are constraints *{+voice}, and (IO)Ident{+voice}, but no *{−voice}. If we are forced to assume a constraint against [−voice], then there can be no genuinely unmarked value of [±voice].

Implicational markedness relationships become even more problematic for a markedness-based approach to dissimilation if we follow Alderete (1997) in assuming that markedness hierarchies hold over self-conjoined constraints. Alderete's proposal is that a universal hierarchy such as |*Labial, *Dorsal ≫ *Coronal| holds also for the self-conjunctions of the same constraints: |*Labial^2, *Dorsal^2 ≫ *Coronal^2|. This comes with a very clear and testable prediction: dissimilation of the less marked value of a feature entails dissimilation of a more marked value. The logic is as follows: if [+voice] is the more marked value, it means there is a hierarchy |*[+voice] ≫ *[−voice]|. This ranking relationship extends to the self-conjunctions of the same constraints: |$*[+\text{voice}]^2 \gg *[-\text{voice}]^2$|. Therefore, if $*[-\text{voice}]^2 \gg$ Ident[voice], then $*[+\text{voice}]^2 \gg$ Ident[voice] follows by transitivity. The result is that any language with voicelessness dissimilation should also have voicing dissimilation. Moro clearly disproves this: voiceless stops dissimilate, but voiced stops do not (e.g. [l-a-bəg-a] 'they are strong'). (We envision markedness hierarchies as fixed rankings here for expository purposes; the same reasoning also holds if the same hierarchy is formalised as stringently related constraints, following de Lacy 2006.)

Our own view on markedness and dissimilation is that, while markedness constraints can interact with similarity-based constraints that drive dissimilation, there is no presupposition that only marked features can dissimilate. By separating markedness from dissimilation, our analysis allows unmarked segments to dissimilate to marked ones, while still allowing markedness constraints to control the output of dissimilation in certain circumstances (such as labials dissimilating to coronals rather than dorsals, as in Alderete's original observation).

3 Processing and perception accounts of dissimilation

Another family of accounts of dissimilation rely on functional explanations. Dissimilation emerges through processing, production or perception difficulties, or from pressure for contrast in the lexicon. We see these as very reasonable proposals about how similarity-avoidance patterns in the lexicon emerge diachronically. In our view, they are not mutually exclusive with one another – nor with our analysis.

Frisch (2004) (see also Frisch *et al.* 2004) argues that the OCP arises through constraints on processing. Languages avoid sequences of similar segments, due to serialisation difficulties in speech production and perception. Similar segments are mutually activated in speech planning, which interferes with correct identification and serialisation of speech. As such, consecutive sequences of similar or repeated consonants are harder to process, and are gradually eliminated over time. Although Frisch (2004) mentions laryngeal features as being implicated in dissimilation, there are no predictions made about the nature of the segments undergoing dissimilation. This type of explanation could conceivably apply to the Moro case, and gradual elimination of morphemes with voiceless–voiceless sequences might account for the not-quite-categorical co-occurrence restrictions we observe in the lexicon (see §2.5). However, we suspect instead that the Moro pattern may have arisen from lexicalisation of earlier alternating patterns of voicing, which are still attested in related languages. In Koalib (Quint 2009), for example, voiceless stops occur word-initially and word-finally, while voiced stops occur intervocalically. This type of distribution may have given rise to an alternating pattern of voicing which has been reinterpreted as dissimilation. A similar case of lexicalised voicing alternations has been proposed for Afrikaans (Coetzee 2014).

Ohala (1981, 1993) proposes a theory of listener coarticulation hypercorrection to account for dissimilation. Under this theory, features that show dissimilation are those with temporally distributed acoustic cues. When an acoustic cue is spread across multiple segments, listeners may attribute it to a neighbouring segment, and adjust their phonological representations to 'undo' this inferred coarticulation. Over time, dissimilation results, as speakers reassign the acoustic cue to its presumed source. Ohala's theory predicts that dissimilation should occur for glottalisation and aspiration, which tend to induce changes in adjacent segments (e.g. creakiness and breathiness). But the cues for voicing distinctions are primarily durational, and therefore internal to the segment; the duration of a stop's VOT is not an acoustic property that can be distributed across neighbouring segments. As such, [+voice] and [−voice] are not predicted to dissimilate by this mechanism. Listener hypercorrection is therefore not a *bona fide* alternative to our analysis of Moro: this theory predicts that patterns like the dissimilation we find in Moro should not arise.

Gallagher (2010a, b, 2011) also proposes a perceptual explanation for dissimilation and phonotactic restrictions on laryngeal features, based on perceptual distinctiveness in the lexicon. She argues that there is a perceptual processing difficulty with two sounds with the same laryngeal feature in the same stem. Perceptual distinctiveness constraints ensure that some languages place restrictions on these kinds of combinations. However, this theory focuses on laryngeal features with the acoustic/auditory feature [long VOT], which is proposed to mark ejectives and aspirated stops. Gallagher (2010b) notes that voiced stops do not pattern with ejectives and aspirates with respect to co-occurrence restrictions, and unaspirated voiceless stops are treated as unmarked. Moreover, since the model treats laryngeal co-occurrence restrictions as a means of enhancing distinctions between roots, it does not offer an explanation for laryngeal feature alternations like those in Moro. Dissimilation of root-final consonants before applicative /-ət̪/ can only ever make roots less distinct; some other explanation is clearly needed for these cases.

While these accounts present interesting perspectives on other types of dissimilation, they do not provide any particular insight or predictions about the pattern of voiceless dissimilation discussed in this paper. The Moro pattern manifests primarily through alternations that happen across morpheme boundaries, which are not explained by lexically focused models (Frisch 2004, Gallagher 2010b); evidence of similarity avoidance in the lexicon is considerably weaker. Ohala's (1981, 1993) listener hypercorrection model seems to have the capacity to explain alternations; but it predicts that [+voice] and [−voice] should not dissimilate. As such, any analysis of Moro based on these accounts must supplement them with some means of representing the synchronic alternations, including locality and domain effects, as we have done here.

ADDITIONAL REFERENCES

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