

The Obligatory Contour Principle and Phonological Rules: A Loss of Identity

McCarthy (1986a) suggests that the Obligatory Contour Principle (henceforth OCP) (Leben (1973)) operates not only as a morpheme structure constraint but also during the derivation as a sort of output condition.¹ In particular, he argues that if the application of a rule would produce an OCP violation, the rule does not apply. If the OCP is active during the derivation in this way, then two other effects might be found. First, the OCP might not only block but also trigger rules. Second, it might condition the mode of application of an otherwise ambiguous rule. In this article I argue that both kinds of effects are found and that the OCP thus acts as a universal constraint on phonological rules. Complete matrices always show OCP effects, but languages differ in which features or groups of features appear on a separate tier and are thus subject to the OCP. Languages also differ in how OCP violations are alleviated.

The OCP is viewed as a filter that can, by marking a representation as ill-formed, require that it be fixed up. The mechanism that effects the change is still a language-particular rule, but of a special type: a rule with no triggering environment of its own. Such a rule can only act if triggered externally by a universal filter, the OCP.² If a language contains no such rule, Tier Conflation eventually separates or merges any remaining violations. Recognizing that the OCP can trigger phonological rules has an interesting consequence: it may then be possible to eliminate identity conditions from phonological rules. A very large class of rules could then be stated as context-free insertion and deletion rules, and alpha-notation would no longer be necessary.

The article is organized as follows. Section 1 defines the OCP, and section 2 gives arguments that the OCP can block rules. Section 3 discusses Tier Conflation, feature

This article has benefited greatly from the comments of a number of people, including John McCarthy, Alan Prince, Donca Steriade, the members of the Brandeis phonology seminar, and an anonymous LI reviewer. All errors are of course my own.

¹ Odden (1986) argues from tonal data for a much more limited use of the OCP and attributes most of its effects to Occam's razor. He assumes, however, that if the OCP were active during a derivation, its effect would be to automatically collapse sequences of identical tones to a single tone. I argue in sections 4 and 5 that this is only one of many possible OCP effects. In fact, most of Odden's examples can then be reinterpreted as evidence *for* the OCP, since many involve epenthesis into identical sequences (Kishambaa, p. 363) or dissimilation (Shona, (2) and (6)).

² Calabrese (1986) has argued that language-specific filters can also trigger rules.

structure, and adjacency. Section 4 outlines the ways in which the OCP could trigger rules. Sections 5 and 6 discuss representative cases in some detail. Section 7 discusses ways in which the form of rules is restricted and simplified by the OCP.

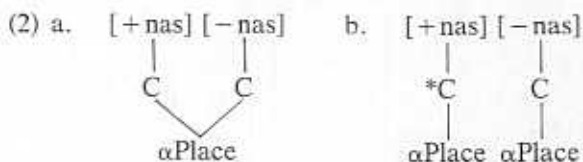
1. What Is the OCP?

The OCP was originally formulated by Leben (1973) to deal with tonal phenomena and was later extended to segments and other single features or groups of features (McCarthy (1981) and many others). The essential idea is that melodies must be "alternating," so that sequences of identical elements are in fact produced by associating a single melody with two skeletal slots. This strongly constrains the underlying representations, as shown in (1) (the formalism here is not Leben's but Goldsmith's (1976)):



Geminate consonants (and long vowels) must be represented by single melodic elements associated with two skeletal slots, and they thus act as units with respect to most phonological rules. (For discussion of the geminate properties of integrity and inviolability, see Steriade (1982), Schein and Steriade (1986), Hayes (1986a).)

If the OCP applies both to full feature matrices and to one kind of submatrix (namely, tone), then it should apply to other submatrices as well. Homorganic nasal-stop clusters [mb, nd, ŋg], for example, must be represented as in (2a), with a single Place node (see section 3.2), not as in (2b):



The OCP is stated formally in (3) (McCarthy (1986a, 208)):

(3) *The Obligatory Contour Principle (OCP)*

At the melodic level, adjacent identical elements are prohibited.

It has been assumed by almost all the researchers mentioned above that the OCP operates as a morpheme structure constraint (MSC) but that the morphology and phonology may freely create OCP violations. Much of the literature of geminate behavior is devoted to discussing the difference between "true" geminates, with a single melodic element, and apparent geminates, with two melodic elements. The latter, of course, would appear to violate the OCP, but their existence during a derivation has rarely been doubted. McCarthy (1986a), however, suggests that the OCP is altogether stronger and more omnipresent than has been commonly supposed. He argues persuasively that the OCP acts during the derivation to block any rule that would create an OCP violation, and it is to his arguments that we now turn.

2. Arguments for the Blocking Effect of the OCP

2.1. McCarthy's Arguments for Antigemination

Several types of rules could in principle result in OCP violations. McCarthy deals with cases of syncope and one case of metathesis; the OCP also blocks certain cases of insertion and feature-changing rules, as I shall show. If a language has a general phonological rule that is blocked just when the output would contain a sequence of identical feature matrices, we can conclude that the OCP is operating to constrain derivations as well as underlying forms. The alternative is an ad hoc condition on such rules, as in (4):

- (4) $A \rightarrow \emptyset / B \text{ ____ } C$
 Condition: $B \neq C$

Such a condition not only incurs an additional cost (whereas the OCP is taken to be universal) but also lacks explanatory power, particularly if contexts B and C are necessary only to state the ad hoc condition.

McCarthy gives an example from Afar, a Cushitic language, which has the syncope rule stated in (5a). The effects of the rule are shown in (5b), and its failure to apply if the two consonants are identical is shown in (5c) (data from Bliese (1981), quoted in McCarthy (1986a)):

- (5) a. $V \rightarrow \emptyset / \#CVC \text{ ____ } CV$
 [- stress]
- | | | | |
|----|---------|-------|----------------------------|
| b. | xamíla | xamlí | 'swampgrass' (acc/nom-gen) |
| | ʕagára | ʕagrí | 'scabies' |
| | digibté | digbé | 'she/I married' |
| | wagerné | wagré | 'we/he reconciled' |
| c. | sababá | | 'reason' |
| | xararé | | 'he burned' |
| | danané | | 'I/he was hurt' |

The failure of the rule in (5c) is attributed to the OCP, and McCarthy argues that surface geminates can in fact only be created by a rule when the two slots are jointly linked, so that no OCP violation results, or in the phonetic component as in fast speech rules. There is an intricate interaction between the possibilities of creating geminates and the process called Tier Conflation (Younes (1983)), because Tier Conflation can affect linkings: I shall return to this point in section 3.

2.2. The OCP Blocks Insertion in Japanese

The OCP also blocks a morphological insertion rule in Japanese. Itô and Mester (1986) discuss the phenomenon known as *Rendaku*, in which the initial obstruent of the second member of a compound becomes voiced, unless the second member already contains a voiced obstruent. Representative data are given in (6):

- (6) a. iro + kami → irogami 'colored paper'
 maki + sushi → makizushi 'rolled sushi'
 yu + toofu → yudoofu 'boiled tofu'
 b. kami + kaze → *kamigaze 'divine wind'
 siro + tabi → *sirodabi 'white tabi'

The blocking effect of voiced obstruents in the second member is known as *Lyman's Law*. Note also that in the native (Yamato) vocabulary morphemes never contain more than one voiced obstruent. Itô and Mester point out in an appendix that both the morpheme structure facts and Lyman's Law can be viewed as the result of the OCP operating on the voicing tier, and they say (p. 71):

If Rendaku voicing is understood as [+voi] entering the voicing tier of the second compound member, the process will be blocked by the OCP whenever a [+voi] is already present.

2.3. The OCP Blocks Feature Changing in English

Borowsky (1986) has argued that English Spirantization is an example of a feature-changing rule that is blocked by the OCP. The rule changes *t* to *s* when followed by *y* in words like those in (7a) (some of which also involve subsequent Palatalization to [ʃ]):

- (7) a. piracy, vacancy, secrecy, presidential, partial
 b. question, digestion, bestial, Christian, honesty

bisʃijal

In (7b) the palatal is [ç], not the [ʃ] that we would expect if Spirantization had applied before Palatalization, showing that the rule fails to apply if an /s/ precedes the /t/, or in other words just when the output would be /ss/. This, of course, is an OCP violation, and the rule can thus be stated rather generally, and the OCP invoked to explain its failure in *question*.

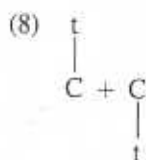
To summarize, McCarthy has argued that the OCP can block rules from applying if they would produce OCP violations, and there is considerable evidence both from syncope and from insertion and feature-changing rules that this is correct. I now turn to the question of how OCP violations can still arise, and whether the OCP forces their removal.

WITHOUT AN EXPLANATION FOR 7b, the ocp can be upheld as
 a generalization, but its implementation in terms of
 association lines is not required

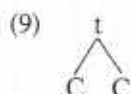
3. Tier Conflation and the Structure of Distinctive Features

3.1. Tier Conflation

If the OCP acts to trigger phonological rules, OCP violations must arise during a derivation. However, two possible sources of OCP violations have already been shown not to occur: MSCs prevent underlying violations, and the blocking effect stops the phonology from producing violations. This leaves the morphology, but McCarthy suggests in an appendix that violations may not arise here either, because of the way Tier Conflation operates. Since morphemes are on separate tiers, initially no OCP violations occur, as shown in (8):



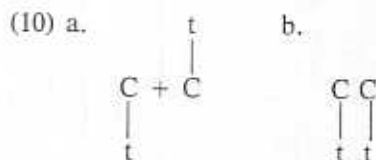
At some point Tier Conflation takes place, but McCarthy suggests at the end of his article that this process might be equivalent to Bracket Erasure (Pesetsky (1979), Kiparsky (1982)) and erase all information that would provide evidence of bracketing. It would therefore eliminate all distinctions between mono- and bimorphemic representations, and since monomorphemic geminates are always single melodic elements, Tier Conflation simplifies such sequences automatically, turning (8) into (9):



There is no stage of the derivation, under this view, in which an OCP violation exists.

This line of reasoning seems to me somewhat problematic. First, Bracket Erasure is only supposed to ensure that direct reference cannot be made to boundary information to distinguish otherwise identical representations; there is no *prima facie* reason why it should be expected to remove all evidence that a form was not monomorphemic in the first place. Carried to its limits, this view is impossible to maintain. Consider a language like Chinese, in which the morpheme is (almost) always monosyllabic. Morphemes can be concatenated in various ways, including compounding and (to a very limited extent) inflection. Since no phonological processes reduce these compounds to a single syllable, it will always be possible to reconstruct the fact that they are bimorphemic, no matter how Bracket Erasure/Tier Conflation are defined. What cannot be reconstructed are the details of the internal bracketing (direction of branching, headedness), and that is appropriate.

Second, since heteromorphemic melodic elements can only be adjacent after Tier Conflation, any rule that needs access to both elements, and in which they are clearly distinct, is evidence against the automatic fusion effect displayed in (9). Such rules include dissimilation across morpheme boundaries, epenthesis into heteromorphemic identical clusters, and indeed all the rules discussed in this article. This is so whether or not the OCP is invoked to trigger these rules. If a rule involves $[\alpha F] \dots [\alpha F]$, the rule cannot identify them as adjacent before Tier Conflation, as in (10a), but will after Tier Conflation, as in (10b):

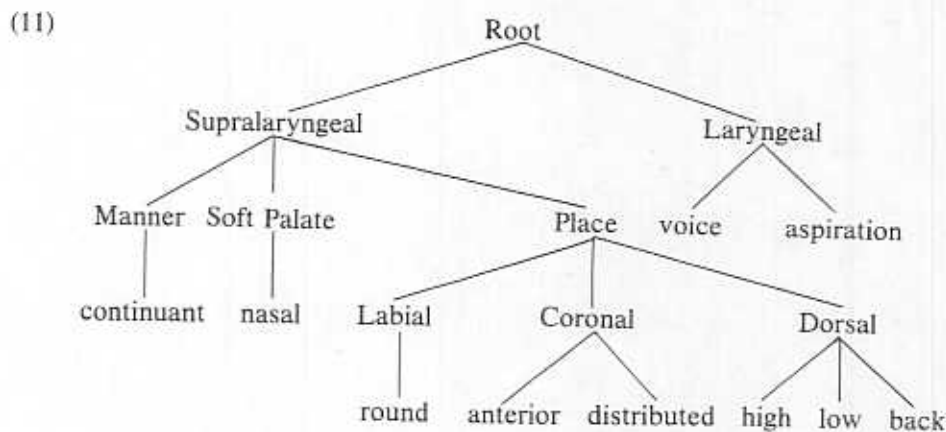


The existence of such rules can thus be taken as evidence for a stage of Tier Conflation

that produces (10b), although a subsequent stage involving automatic fusion, (9), is clearly also necessary. For example, McCarthy gives some evidence from Hebrew suggesting that Spirantization, which follows all Tier Conflation, fails to apply to both mono- and bimorphemic geminates, and he concludes that Tier Conflation does indeed fuse identical melodic elements. He points out, however, that little conclusive evidence is available on this point.³ I shall henceforth assume two stages in Tier Conflation, with only the second stage producing this automatic fusion. Rules may intervene between the two stages of Tier Conflation; if no such rules exist, only the output of final Tier Conflation will be visible.

3.2. *The Structure of the Feature System and Long-Distance OCP Effects*

Clements (1985), Sagey (1986), McCarthy (1986b), and others have shown that distinctive features make up a tree structure whose terminal nodes are single features that in turn are dominated by higher-order articulator nodes and class nodes, until eventually the whole tree is dominated by a root node, which is associated with the CV tier. (11) illustrates a partial representation of the type Sagey proposes, though I follow Clements, not Sagey, in showing a Manner node, and in putting it under the Supralaryngeal node rather than directly under the Root:



The features are grouped into constituents that can act as units in rules, either spreading (the Place node, for place-of-articulation assimilation) or deleting (the Supralaryngeal node, in Icelandic preaspiration; see Thráinsson (1978)).

The feature array in (11) can be thought of like the pages of a book: each skeletal slot has one of these arrays associated with it, and similar elements on neighboring pages are *adjacent*. So the Place nodes of two adjacent consonants are adjacent Place nodes,

³ It seems likely that this fusion happens at the end of the lexical phonology, much as Goldsmith (1976) argues for tone, so that languages cannot distinguish phonetically between single vowels with LH, LLH, and LHH by the timing of the rise. See also Odden (1986, 370–371) on Kipare Final Lowering.

and so on. A nonterminal node is present only if the articulator is activated; for example, only coronal consonants have Coronal nodes, and [-coronal] does not exist.

Once this idea is combined with the notion of underspecification (Kiparsky (1982), Archangeli (1984), D. Pulleyblank (1986)), an interesting consequence arises. If a node/feature is missing from a given segment, the comparable nodes/features of the next-door segments will be adjacent, since nothing will intervene. It is therefore possible to predict the existence of long-distance effects from the structure of the feature system together with underspecification.

Can we then dispense with specifying special tiers for languages with long-distance effects? Two kinds of cases arise. First, there are certain features that are (nearly) always unspecified for certain classes of sounds. Tonal features are usually unspecified for consonants, for example. Such features will typically exhibit autosegmental behavior. Second, there are features that are usually unspecified for one class of sounds, but in some languages they may be specified for all sounds. The features [high, back] are usually unspecified on consonants, but in some languages they are distinctive (and therefore specified) in consonants too. In a language in which the consonants are unspecified the features [high, back] will be adjacent on neighboring vowels, and vowel harmony can arise. If the consonants are specified for these features, however, they will interrupt the harmony.

However, special tiers are apparently still needed. Notice that if vowel harmony is made possible by the lack of specification for vowel features on consonants, then consonant harmony of various types (Coronal, continuancy, voicing assimilation) should be made possible by the presumed lack of specification for Coronal, continuancy, and voicing in vowels. Although all these are indeed found, as we shall see, they are much rarer than one would expect given the theory expounded here. I conclude that some device like language-particular special tiers is still needed, and that long-distance effects will only be found if the relevant nodes form a tier in that language. However, hierarchical feature theory can be used to drastically constrain what is or is not a possible tier. I give the following constraint on what can be a tier:

- (12) Only constituents may constitute tiers.

Note that constituents may be terminal nodes (that is, features) or nonterminal nodes (for instance, articulator nodes). Markedness theory must allow for the fact that the superordinate nodes constitute tiers more often than the subordinate nodes (Roots and Tones are always tiers, Laryngeal nodes nearly always, Manner nodes quite rarely, and so on). Note also that long-distance effects will only show up if both a separate tier *and* unspecified elements are present. As a result, some features show more long-distance effects than others, but this is largely an illusion resulting from the greater frequency of underspecification for the relevant features. Archangeli and Pulleyblank (1986) and Steriade (1987) suggest that a fuller understanding of the interaction of underspecification and feature structure may make stipulation of tiers unnecessary, but I shall continue to stipulate such tiers in this article.

3.3. Tier Conflation and Long-Distance Effects

McCarthy's formulation of the OCP makes reference to adjacent elements on a tier, and the stricture on possible tiers means that the OCP can only apply to constituents, since only these constitute tiers. Long-distance adjacency (and thus long-distance OCP effects) will arise if both an activated tier and underspecified intervening elements are present. For example, suppose that a language prohibits two glottal stops in the same syllable. If this is indeed an OCP phenomenon, there must be some level at which the onset and coda glottal stops can be considered adjacent, and this will be so if the language has a glottal tier (perhaps a supralaryngeal tier) and if the intervening vowel is not specified for the feature [constricted glottis].

There is considerable evidence from morpheme structure phenomena that the OCP does operate on tiers other than the root tier. The best-known examples come from Semitic (McCarthy (1986b)), but non-Semitic languages in which consonants and vowels are not obviously separated may still have cooccurrence restrictions on consonants in the same morpheme. Javanese is one such case (Uhlenbeck (1950), Mester (1986)); Cantonese is another (Light (1977), Hashimoto (1972)). The most obvious way to handle these facts is to assume that in such languages the relevant feature bundles, such as place-of-articulation features, are on a separate tier and hence subject to the OCP. Since they are on a separate tier, adjacency on that tier is the relevant adjacency, and provided the intervening segments are unspecified for those particular features the OCP will produce the observed effects.⁴

In addition to creating adjacent OCP violations that must be fixed up by the phonology (or by later fusion), Tier Conflation will also create long-distance OCP violations involving single features or higher-order constituents on a particular tier. Consider the following facts from Akkadian (McCarthy (1981), Von Soden (1969)). Akkadian allows only one labial per root, showing that the OCP operates on the Labial tier. When the nominal prefix *ma-* is added to a root including a labial, it dissimilates to *na-*:

(13)	naphar	'totality'
	neereb	'entrance'
	narkabt	'chariot'

The target and trigger are in different morphemes, so if adjacency is involved, the dissimilation must apply after the morphemes have been conflated, giving a single Labial tier; then the OCP, I would claim, triggers a rule of dissimilation at that level.⁵ The relevant stage is shown schematically in (14):

⁴ Hayes (1986b, 494–496) argues that the OCP cannot hold on subtiers in Toba Batak. This is because underlying /kp/ clusters, which would share a feature bundle [-nasal, -voice, -spread, -constricted], must be distinguished from [kp] derived from /np/ in that they do not undergo a Glottal Formation Rule. However, the putative shared features are probably the unspecified features for obstruents in Toba Batak, so there would be no possibility of an underlying OCP violation involving these features anyway.

⁵ The dissimilation is not triggered by rounded stem vowels, nor by (or in) the later suffix *-um*. This suggests the following stages:

1. *ma-* prefixation
2. Conflation of morphemes, /u/ still unspecified for Labial

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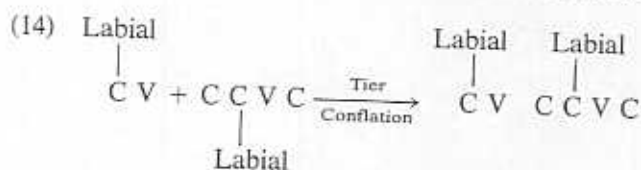
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4. The OCP as a Rule Trigger

4.1. The OCP and Identity in Rules

In the remainder of this article I shall be concerned with the ways in which the OCP can condition rule applications. Any rule whose structural description in traditional terms includes a target and a trigger that crucially share some feature or features is a possible candidate for such conditioning. The rules themselves, of course, do not become obsolete; only the environment, I shall claim, can be eliminated and attributed to a more fundamental property of the language: the features over which the OCP is applicable as a result of tier structure and underspecification. There is a large class of such rules, but I shall limit the discussion to one example of each type.

I should add that I would like to take the strongest possible position: all rules involving identity of target and trigger with an output in which they are no longer identical and adjacent are OCP-triggered rules.⁶ The kind of case that would, I think, require a weakening of this claim would be a language with the following properties:

- (i) Dissimilation of F: $\alpha F \rightarrow -\alpha F / _ \alpha F$
- (ii) Demonstrable morpheme-internal $\alpha F \alpha F$ sequences, as opposed to doubly linked αF

(ii) would show that the OCP did not operate on $\alpha F \alpha F$ sequences. It thus could not act to trigger a rule like (i). No such cases are known to me at present.

If an OCP violation arises in a language, there are in principle three different ways of fixing things up (in addition to final Tier Conflation):

1. Deletion of one element

- a. Degemination: Empty slot never realized
- b. Dissimilation: Default rules supply unspecified value
- c. Assimilation: Adjacent node spreads onto empty position⁷

3. OCP violations arise from (2) and are fixed up by dissimilation
4. Full Tier Conflation; default values of Labial supplied
5. *-um* suffixation

Assuming that *ma-* and *-um* are in different lexical strata, the unsurprising conclusion is that Tier Conflation, like Bracket Erasure, must apply at least at the end of each stratum.

⁶ An LI reviewer has raised the question of whether other kinds of rules can require identity. The answer is apparently yes. For example, there are vowel harmony rules that spread [round] if both target and trigger have the same value for [high], and where backness remains unchanged. Perhaps the difference is that such rules are more complex than equivalent rules without the identity requirement, whereas for the rules discussed here this is not the case.

⁷ The high frequency of assimilation under these circumstances may be the result of a tendency for languages to have rules spreading onto empty slots, instead of leaving them for the redundancy rules to fill in.

Thus, α -
predicates
are needed
anyway.

2. *Separation of matrices*
 - a. Epenthesis: Insertion of a blocking node
 - b. Metathesis: Movement away of one node
3. *Change of one node to opposite value*
 - a. Dissimilation: Probably not necessary, due to (1b)

I shall give examples of each of these, in varying amounts of detail.

4.2. Rule Statements

I have suggested that the OCP can trigger several different kinds of phonological rule in which the environment crucially includes two identical elements. I shall now make precise the way in which the OCP triggers phonological rules.

The main contribution of the OCP is that it allows us to separate out condition and cure. The OCP is a trigger, a pressure for change, but the cure must be specified by the language, and if the language lacks a curative rule, the condition persists until relief appears in the form of Tier Conflation (see section 3). I assume that rules can only apply if four things are specified: a Domain (syllable, word); a Tier; a Trigger; and a Change (delete, insert, spread). A rule like English Velar Softening specifies all of these and is therefore self-sufficient. However, there is a class of rules in languages that have no specified triggering environments; in order for such a rule to apply, it must be completed by the provision of an environment from some other source. If this source is an independently needed universal principle, such as the OCP, then the rule can be counted a simpler rule than one that needs its own idiosyncratic environmental specification. OCP-triggered rules like dissimilation, degemination, and some assimilation and epenthesis rules are, under this view, simple kinds of rules whose high frequency is thus intelligible. The identity requirements of the rules are no longer chance, but a direct result of the rules' minimal (that is, unspecified) environments.

The question arises as to *how* the OCP triggers phonological rules, and what class of rules is so triggered. The rules themselves are reduced to their bare essentials, and this may be the key. A rule that says only "Insert slot" or "Delete left matrix" can be viewed as unintelligible in the absence of further instructions, and the OCP provides these instructions. In a sense, then, its role in conditioning insertions and deletions is strictly akin to its role in conditioning ambiguous rules like Kasem Vowel Deletion (see section 6), since these rules too are ambiguous without its mediation. Contrast this with a more finicky rule like English Velar Softening (*electric/electricity*), which is self-sufficient in that all the necessary information is encoded into the rule itself.

Note that the rule itself is still part of the grammar of the particular language. The OCP can trigger many types of rule, and which one exists in a language is not obviously predictable. Only the environment can be removed. Moreover, a language may apparently lack an appropriate rule. The OCP, in other words, will trigger a rule if one exists; but if one does not exist, its effect will be felt only when final Tier Conflation takes

place, at which point sequences will be collapsed into single elements, as suggested by McCarthy. It is thus not an absolute rule *trigger*, whereas it is an absolute rule *blocker*.

In the remainder of this article rules will be stated in the following form:

- (15) *Domain:* Rhyme/Syllable/Word
Tier: Laryngeal/Coronal/ . . .
Trigger:
Change: Delete/Insert/Spread/Move

The Trigger will usually be left blank, and the rule will operate only if triggered by the OCP. Other details will be discussed as they arise. (For an independent look at stating rules in a rather similar way, see Archangeli and Pulleyblank (1986).) With these assumptions made explicit, let us turn to real cases in which the OCP triggers the operation of a phonological rule.

5. Examples of the OCP as Rule Trigger

5.1. *Seri Glottal Degemination*

Seri (Marlett and Stemberger (1983)) has a rule called Glottal Degemination that deletes a glottal stop preceded by another glottal stop in the same syllable. The data are given in (16):

- (16) a. $\text{ʔa-a:ʔ-sanx} \rightarrow \text{ʔa:-sanx}$ 'who was carried'
 b. $\text{ʔi-ʔ-a:ʔ-kašni} \rightarrow \text{ʔi-ʔ-a:kašni}$ 'my being bitten'

Notice that the rule applies only to tautosyllabic glottal stops, so the second glottal stop in (16b) is not affected. Glottal stops in coda position are quite acceptable in other circumstances: *koʔpanšX* 'Run like him!'.⁸

Marlett and Stemberger's statement of the rule responsible is given in (17) (their (34)):⁸

- (17) $\begin{array}{ccc} \text{On} & \text{Nu} & \text{Co} \\ | & | & | \\ \text{C} & \text{C} & \text{C} \\ | & | & | \\ \text{ʔ} & \text{ʔ} & \text{ʔ} \end{array} \rightarrow \begin{array}{cc} \text{On} & \text{Nu} \\ | & | \\ \text{C} & \text{C} \\ | & | \\ \text{ʔ} & \text{ʔ} \end{array} \quad \emptyset$

Statements like this, though entirely adequate descriptively, fail to capture one central property of rules of this kind: they are degemination rules, not random deletion rules. Marlett and Stemberger of course recognize this fact, and call the rule ʔ-Degemination , but the statement of the rule itself makes no such claim. An identical rule in which the

⁸ Marlett (1981) points out that *ʔ* always occurs next to a vowel, so that it is the last C in an onset and the first in a coda. It may thus be part of the nucleus, and the domain of the rule may be the nucleus. Unfortunately, Marlett gives no information on morpheme-internal cooccurrence restrictions. I should note that he points out (p. 129, fn. 19) that this rule does not apply in some environments where it would be expected to apply, but he gives insufficient data to determine why.

triggering consonant was /p/ instead of /ʔ/ would be equally ranked by an evaluation metric; yet languages rarely have such rules, and the theory should clearly assign them a greater cost. In other words, the fact that the trigger and the target have the same features is a fundamental characteristic of this and similar rules in other languages, and the insight that degemination is involved must be made explicit.

The OCP offers a way of doing just this. First notice that Laryngeal features frequently (perhaps usually) form a separate tier from Supralaryngeal features. Tone is the most obvious example, but aspiration in Icelandic (Thráinsson (1978)) and glottalization and tone in Zahao and Thai (Yip (1982b)) are other cases. Glottalization is the only entry on this tier in Seri, which has no phonemic contrasts in aspiration or voicing. We can thus assume that the Laryngeal node is absent except for /ʔ/, and the entries for glottalization in (17) are thus adjacent and identical and violate the OCP. This violation triggers a rule that operates in the domain of the syllable, and the language chooses the first of the possibilities laid out in section 4, deletion of one matrix (either [+constricted glottis] or [Laryngeal]). The actual rule has four parts, as shown in (18):

- (18) *Glottal Degemination*
 Domain: Syllable
 Tier: Laryngeal
 Trigger:
 Change: Delete second⁹

The environment is not stated, so the rule is unable to operate unless triggered "from outside." The outside trigger is of course the OCP, a universal principle and thus free of charge. The evaluation metric should thus assign this rule a lower cost than a rule whose triggering environment must be explicitly stated in the rule itself.

Deletion of the Laryngeal node leaves a slot empty, since /ʔ/ presumably has no Supralaryngeal node. Since Seri does not allow any leftward spreading, nor any spreading of /ʔ/, the slot remains empty and does not surface. The evidence that Seri does not spread /ʔ/ comes from roots that begin with an empty C slot. This causes gemination of prefix consonants, with the single exception of /ʔ/:

- (19)
- | | |
|-------------|----------|
| i: | 'feel' |
| i-tt-i: | neutral |
| i-ss-i: | irrealis |
| but -a:ʔ-i: | passive |
| *-a:ʔʔ-i: | |

Marlett and Stemberger observe that Seri must thus be assumed to prohibit /ʔ/ attached to more than one skeletal position: in my terms, the Supralaryngeal node spreads, but the Laryngeal node does not.¹⁰

The remaining piece of the puzzle would be evidence that Seri has an MSC pro-

⁹ Identifying the victim of the rule as first/second could also be achieved by directional left-to-right application, as has been pointed out to me by an LI reviewer.

¹⁰ Hebrew has a similar prohibition against spreading any of the gutturals.

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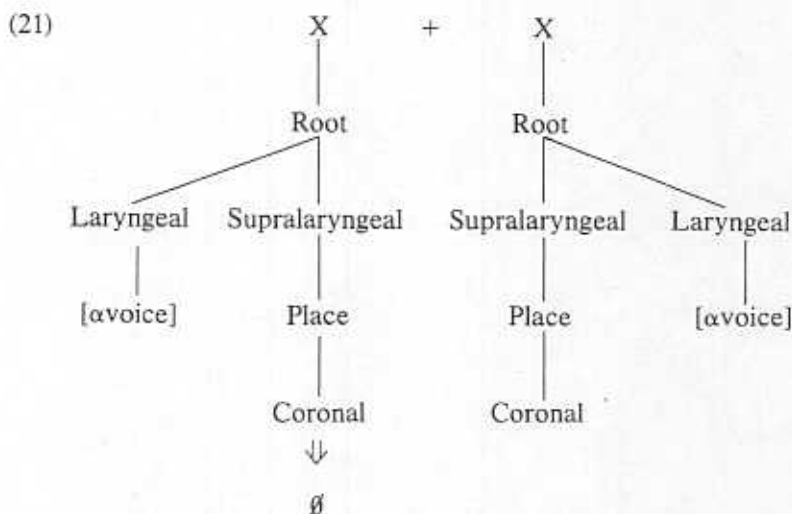
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As a doubly linked structure, the output of this rule is exempt from undergoing an otherwise general rule of Schwa Epenthesis that breaks up triconsonantal clusters. So we find [ddlu], not *[dɔdlu]. This is true even when (20b) has applied vacuously: $t + trəz \rightarrow ttrəz$ *[tɔtrəz].

This rule has a serious shortcoming, however. The presence of [+coronal] is unexplained, and the rule could as well assimilate a labial in voicing to a following velar. At this point the details of feature geometry become relevant. I suggest that Berber has a Coronal tier and that a sequence of two [Coronal] nodes thus violates the OCP in Berber.¹² A better representation of the situation is given in (21):



The OCP is violated on the Coronal tier, and Berber, like Seri, takes the option of deleting one of the offending matrices (the first in this case). Unlike Seri, Berber clearly permits spreading, and there are four possible ways to spread Coronal onto the first consonant. Either the lowest node, Coronal itself, can spread, or the highest (Root) node, or either of the intervening Supralaryngeal and Place nodes. Since voicing assimilates, it is clearly the Root node—the highest possible node—that spreads, since the two segments are string-adjacent. The rule is thus maximal in the sense of Archangeli and Pulleyblank (1986). We shall see that in Chumash the highest spreadable node is Coronal, since the delinked segment is not string-adjacent to the spreading node.¹³

The Berber rule of Voicing Assimilation can now be reduced to the operation of

¹² Of course, in many languages coronal sequences persist until fused by Tier Conflation, but Berber is not alone in having a rule triggered by the OCP on the Coronal tier. In section 5.5 I shall argue that English has several.

¹³ It is also possible that the spreading itself alleviates the OCP violation, but this is not obviously so, since the offending matrix would still be present, albeit delinked. For this reason I have assumed it is first deleted by the OCP-triggered rule, and this then leaves it empty and available for a spreading rule.

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the OCP on the Coronal tier, plus an instruction to delete the first matrix, and independently motivated spreading. A formal statement of the rule is given in (22):

(22) *Berber Voicing Assimilation*

Domain: Word

Tier: Coronal

Trigger:

Change: Delete first matrix

Again, then, the requirement of a phonological rule that the target and trigger share a feature becomes more than chance if the OCP's role is understood. And returning again to the methods of undoing OCP violations laid out in section 4, Berber Voicing Assimilation illustrates deletion of a feature matrix, but with concomitant spreading resulting in total assimilation.

5.3. *Chumash Coronal Harmony*

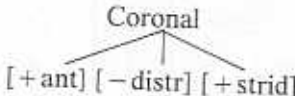
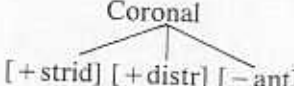
Another type of rule can be understood in exactly the same way. There is a particular type of harmony system exemplified by Chumash sibilant harmony (Beeler (1970)) in which all sibilants must agree in point of articulation with the suffixal sibilant, and in which both trigger and target must be specified underlyingly. In (23) I give some relevant facts:

- (23) a. osos 'heel' šuš 'fur'
 ac'is 'beard' č'umaš' 'islanders'
- b. k-iškín 'I save it' k-iskín-us 'I save it for him'
 k-ackáw 'I sin' ačkáw-iš 'a sin'
- c. k-saqtinan'-us 'I tell him a story'
 snoxš/šnoxš 'its head'

(23a) shows that within a root all coronal sibilants must agree in place of articulation, including the features [anterior] and [distributed]. (23b) shows that harmony is triggered by the suffixal sibilant, which can force a change from [+distributed] to [-distributed] or vice versa. (23c) shows that the rule can skip over coronal *t*, and *n*, and (apparently optionally) the continuant *x*. The interesting fact is that the participating class of segments, [Coronal, +continuant], is not a constituent in the Clements/Sagey framework. In fact, the feature [continuant] cannot be relevant, since the rule involves affricates, which are only [+continuant] at their right edges and yet both cause and undergo the harmony rule. The other feature that coronal continuants and affricates share is [+strident], suggesting that the true class is [Coronal, +strident]. But this is still not a constituent, since stridency is under the Manner node. I shall claim that stridency, a feature whose main justification is the *s/θ* distinction,¹⁴ is in fact under the Coronal node and that a universal default rule assigns [-strident] to [-continuant] segments.

¹⁴ The only clear counterexample to this is the Ewe labiodental/bilabial distinction, which might conceivably be [round].

The representations of *s* and *ʃ* will now be as in (24a) and (24b), respectively:

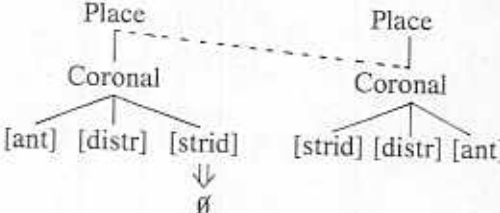
- (24) a.  b. 

These and the affricates will be the only strident elements, since the stops acquire stridency by the default rule, and noncoronals, including vowels, do not have a Coronal node and therefore cannot have a stridency specification.

Given this structure, plus the assumption that Chumash has a strident tier, the harmony facts can be dealt with by the rule in (25):

- (25) *Chumash Sibilant Harmony*
 Domain: Word
 Tier: Strident
 Trigger:
 Change: Delete first

This rule is triggered by the OCP and followed by spreading of the highest node that can spread long distance—in this case, the entire Coronal node:

- (26) 

Any feature that is dominated by Coronal will spread with it, resulting in total Place assimilation. Since the same restriction holds within the root, it is clear that this is also an MSC that holds on nonadjacent consonants, providing clear evidence for the need to refer to a separate strident tier in Chumash but not in English, where the plural rules also refer to this class of sounds, but only when they are string-adjacent.

This example concludes the section on the OCP as a trigger of deletion rules. The claim is that rules in which identity of features is an essential part of the environment of the rule are always conditioned by the OCP, and that the rule itself consists of an instruction (such as "Delete first/second") and a domain (such as the syllable). The tier that is subject to the OCP partially determines the environment, and the presence or absence of spreading determines the eventual effect: degemination or total assimilation.

5.4. Dissimilation: Cantonese

Another possible result of deleting a feature matrix occurs if deletion is followed by application of redundancy rules that insert the opposite value of the deleted feature(s), as in 1b in section 4.1. This of course is dissimilation, and such rules are widely found

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in natural languages. An alternative path to dissimilation, closer to the traditional account, involves a change in one of the two identical feature matrices, as in 2 in section 4.1. I shall assume that dissimilation results from application of default rules after deletion; but in any event the central claim I wish to make is that the OCP is the trigger for dissimilation of either kind, so that the fact that identical matrices are involved is not coincidental, and these rules, since they do not need their own trigger specified, are simpler than logically possible but nonoccurring (or rare) rules in which, say, high vowels become mid before rounded vowels.

I shall examine one case in some detail. Cantonese has a constraint on the co-occurrence of rounded vowels and labial consonants in the same syllable. I shall show that this operates as an MSC, and on nonadjacent segments. The feature involved must thus be on a separate tier. Then I shall show that this constraint operates synchronically during the derivation to trigger a dissimilation rule and to block a feature-changing rule. Finally I shall point out that it has also been active historically to trigger dissimilation in the same way. The data in the following sections come from Hashimoto (1972) and Light (1977). Some details are omitted.

5.4.1. Morpheme Structure Constraint on Labial. Cantonese has a well-known MSC that prohibits certain combinations of rounded vowels and labial consonants. The maximal morpheme is a single CVC syllable. I shall follow Sagey in assuming that the Labial articulator node is activated in both Labial consonants and rounded vowels, but that only the latter are also specified [+round]. Note that Cantonese has both front and back rounded vowels.

The strongest prohibition holds within the rhyme: a rounded vowel (front or back) followed by a labial consonant (*p* or *m*) is completely impossible, as shown in (27a). Unlike the other constraints discussed below, this holds even for borrowed words.¹⁵

- (27) a. Rhyme-internally:
 * V C
 | |
 Labial Labial **tup*, **kəm*

The second constraint is weaker and holds between the onset and the nucleus. Labial consonants may precede back rounded vowels, but not front rounded vowels. This is shown in (27b):¹⁶

- (27) b. Syllable-internally:
 * C V
 | /
 Labial Labial [-back] **møü*, **pü*, **pæŋ*
mou, *puk*, *fu*

¹⁵ What happens in borrowed words is not quite clear. The only example I have been able to find is *Rome*, which is borrowed as the bisyllabic [lɔma], perhaps since [lɔm] would violate the MSC. However, this may be a direct borrowing from the bisyllabic Italian *Roma*, so it is hardly conclusive.

¹⁶ The rhyme /ou/ is permissible because it has a schwa-like nuclear vowel whose surface rounding comes from the final rounded glide.

The last MSC holds between the nonadjacent onset and coda, which may not both be labial consonants. This is shown in (27c):¹⁷

- (27) c. Onset-Coda:
 * C V C
 | |
 Labial Labial *pim, *ma:p

The difference between front and back rounded vowels in (27b) is intriguing. One might assume that only front rounded vowels are marked for Labial articulation and are therefore identifiable as Labial and subject to the prohibition. Unfortunately this would make it impossible to characterize the stronger rhyme-internal prohibition illustrated in (27a), in which both front and back rounded vowels must be identifiable as Labial. One possibility is to make use of the kind of syllable-structure building rules found in Steriade (1982). Only front rounded vowels are underlyingly marked Labial. When syllable structure is built, first the prevocalic consonant is marked as an onset, then redundant values of [round] are assigned, including [+round] for the nonlow back vowels. Assigning a value of a terminal feature like [+round] automatically entails assigning the superordinate articulator node, in this case Labial. Then postvocalic Cs are marked as codas. The order is thus:

- (i) Create onsets: pu but *pū
- (ii) Redundancy rules for [+round] apply
- (iii) Create codas: *up, *ūp

At the point when onsets are identified the sequence CV is under scrutiny, and at this point only front Vs are marked [+round], Labial. They are thus prohibited from occurring with Labial onsets, but back (eventually rounded) vowels are not. Then *all* vowels are specified for [+round], Labial, and codas are attached. When VC is inspected, then, *all* [+round], Labial vowels will be blocked from occurring with Labial codas.

The data in (27a-c) show the existence of a widespread MSC involving the Labial node. Because the intervening vowel will never have a Labial articulator node, the constraint holds between nonadjacent initial and final segments as well as adjacent ones. The OCP then prohibits more than one Labial specification.

5.4.2. *The OCP as a Trigger of Dissimilation.* I now proceed to discuss the evidence for the OCP as a trigger of phonological rules. Cantonese has extremely little in the way of morphology and very few phonological rules. In order to find any relevant rules, it is necessary to look at a secret language discussed in Chao (1931). The analysis is essentially that of Yip (1982a), to which the reader is referred for greater detail.

¹⁷ This constraint is sometimes violated in onomatopoeic words and loanwords, such as /pəm/ 'pump'. (See Bauer (1985) for three or four other examples.) There are other onset-coda restrictions involving labiovelars and /w/, so that /pau/ is all right but /kwau/ is not. This may involve backness, but I will not discuss it here for reasons of length.

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The secret language, known as La-mi, turns each syllable of the base language into two syllables. One way to view this change is that whereas the base language has one syllable per morpheme, the secret language has two syllables per morpheme. Typical examples are given in (28):

- (28) yat → lat yit
kei → lei ki

The secret language is formed by reduplication and association with a bisyllabic template that already has /l/ and /i/ associated with it. The morpheme template for the secret language is given in (29a), and a typical derivation is given in (29b):

- (29) a. $\begin{array}{c} l \\ | \\ CVC \end{array} + \begin{array}{c} i \\ | \\ CVC \end{array}$ b. $\begin{array}{c} l \\ | \\ CVC \\ | \\ y \end{array} \begin{array}{c} i \\ | \\ CVC \\ | \\ a \end{array} \begin{array}{c} l \\ | \\ CVC \\ | \\ t \end{array} \begin{array}{c} i \\ | \\ CVC \\ | \\ y \end{array} \begin{array}{c} l \\ | \\ CVC \\ | \\ a \end{array} \begin{array}{c} i \\ | \\ CVC \\ | \\ t \end{array}$

Notice that the final consonant of the base is reduplicated. Of interest here is what happens if the base has a final labial consonant. The data are given in (30):

- (30) sap → lap sip → lap sit
t'im → lim t'im → lim t'in

The second final consonant dissimilates to a coronal. Note that this does not happen within the standard language morphology, where bimorphemic compounds and reduplicates can freely contain two labials: *lap lap lün* 'disorderly', *sa:m sap* 'thirty'.

Given the existence of the MSC prohibiting two Labial elements, this is not surprising. In the secret language we are dealing with what might be called a derived morpheme, as opposed to a bimorphemic form. Thus, the OCP violation is real and must be alleviated. Cantonese takes the option of dissimilation, which is schematized in (31):

- (31) $\begin{array}{c} l \\ | \\ CVC \\ | \\ s \end{array} \begin{array}{c} i \\ | \\ CVC \\ | \\ a \end{array} \begin{array}{c} l \\ | \\ CVC \\ | \\ p \end{array} + \begin{array}{c} l \\ | \\ CVC \\ | \\ s \end{array} \begin{array}{c} i \\ | \\ CVC \\ | \\ a \end{array} \begin{array}{c} l \\ | \\ CVC \\ | \\ p \end{array}$
Labial Labial → Nonlabial

Exactly what happens formally is debatable. In a more traditional account of features the change would be from [+labial] to [-labial], or perhaps from [-coronal] to [+coronal]. Sagey claims, however, that articulator nodes are simply present or not present, so that -Labial does not exist. Let us then assume that the Labial node is deleted by the rule and that the redundancy rules supply a Coronal node instead. This shows the third possible outcome of a deletion under identity rule: dissimilation. The rule is given

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in (32):

- (32) *Labial Dissimilation*
 Domain: Morpheme
 Tier: Labial
 Trigger:
 Change: Delete second

So far, then, we have seen that the OCP operates on the Labial node in two ways: as an MSC, and to trigger a rule of dissimilation. I now turn to a third effect: the OCP also blocks the application of a rule that inserts [+round] (and thus necessarily the superordinate Labial) exactly when the rule would otherwise produce an OCP violation.

5.4.3. *The OCP as a Rule Blocker.* The secret language has a further rule that changes /i/ to /u/ when both nuclear vowels in the output would be /i/. However, the rule fails to apply if the input has a labial coda (but Labial Dissimilation applies normally). The data are given in (33); the actual surface form in (33b) is italicized:

- (33) a. kin → lin kin → lin kun
 yit → lit yit → lit yut
 b. t'im $\xrightarrow[\text{Formation}]{\text{Secret Language}}$ lim t'im $\xrightarrow[\text{Dissimilation}]{\text{Labial}}$ *lim t'in* $\xrightarrow{i \rightarrow u}$ *lim t'un

I shall not be concerned here with formulating this rule precisely,¹⁸ but it clearly involves backing and rounding the vowel, and the rounding part of the change interacts crucially with the unrounding involved in Labial Dissimilation.¹⁹

The failure of $i \rightarrow u$ in (33b) is somewhat unexpected, since both syllables of the nonexistent output */lim t'un/ can occur in the secret language, and neither of them involves an OCP violation. Let us consider the consequences of applying the two rules in either order. It is clear that $i \rightarrow u$ could not apply before Labial Dissimilation, since this would give the derivation in (34), with a flagrant OCP violation in the rhyme of the second syllable of the intermediate form, */t'um/:

- (34) t'im $\xrightarrow[\text{Formation}]{\text{Secret Language}}$ lim t'im $\xrightarrow{i \rightarrow u}$ *lim t'um $\xrightarrow[\text{Dissimilation}]{\text{Labial}}$ *lim t'un

(35) gives a more formal representation of the illicit insertion of [+round] (and therefore

¹⁸ It is likely that the $i \rightarrow u$ rule is also triggered by the OCP, since there is slight evidence of an MSC involving high front vowels. Hashimoto gives no /yei/, /yoi/, or /yui/, only one /yai/, and four /yoi/. The palatoalveolars /ts, ts', s/ also have a restricted distribution.

¹⁹ E. Sagey (personal communication) has pointed out that the onset /y/ in (33) should block or participate in the $i \rightarrow u$ dissimilation. Perhaps only nuclei are affected.

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There is another way of thinking about the difference between Middle Chinese and Cantonese with respect to Labial Dissimilation. Suppose the rule, (32), came into the language at the relevant time. Before the existence of the rule Proto-Cantonese, like English, freely allowed syllables with Labial onsets, nuclei, and codas. Given a theory of feature structure like Sagey's, however, the Labial sequences would still have been adjacent and thus violated the OCP, but in the absence of a rule they would persist until Tier Conflation took care of them either by making them no longer adjacent or by conflating them into a single specification if adjacent. Under this view, the OCP can be understood as a diachronic pressure for change, making the introduction of a rule like (32) more likely.

I have shown that Cantonese observes the OCP with respect to the node Labial in four ways: as a synchronic MSC, as a synchronic rule blocker and rule trigger, and as a diachronic rule trigger. An account of these facts without recourse to the OCP would fail to capture the relationship among them and would thus never rise above description.

5.5. Epenthesis: English Coronals

I now turn to a different kind of OCP-triggered rule: separation of the two identical matrices by epenthesis. My primary example will be taken from English, which exhibits widespread evidence of OCP effects involving the Coronal node. Violations are resolved in several ways, including epenthesis, deletion of one matrix (degemination), and spreading of the Coronal node (assimilation of Place features). Understanding the role of the OCP achieves two things. First, each rule can be considerably simplified since the environment can be eliminated from the statement of the rule. Second, three distinct phenomena can now be related, since they all result from the triggering effect of the OCP.

5.5.1. Plural and Past Tense Rule. I shall first discuss the best-known case, the plural, and argue that Epenthesis here is triggered by an OCP violation. I shall not have space to justify an epenthesis analysis over a deletion analysis; I simply note that if the rule is instead a deletion rule, then it still shows OCP effects, but in blocking the deletion rule from applying between two like coronals rather than in triggering an insertion rule. See Borowsky (1986) for an interesting account along these lines.

It is well known that English inserts a vowel between two "like coronals" in the plural/genitive/present tense/contracted verb *to be* and in the past tense. The relevant data are given in (38):

- (38) a. fishes, garages, churches, judges, horses, buzzes
b. wanted, needed

A traditional statement of the rule, modified from Anderson (1974, 58), is given in (39):

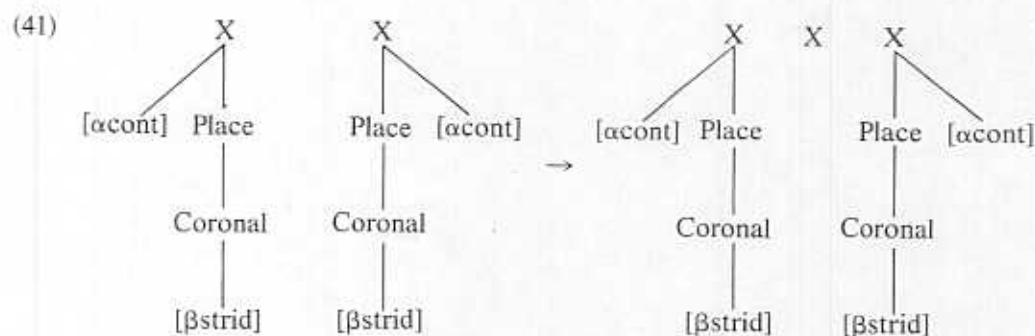
$$(39) \emptyset \rightarrow i / \left[\begin{array}{c} + \text{cor} \\ + \text{obst} \\ \alpha \text{strid} \\ \beta \text{cont} \end{array} \right] \# \text{ — } \left[\begin{array}{c} + \text{cor} \\ + \text{obst} \\ \alpha \text{strid} \\ \beta \text{cont} \end{array} \right]$$

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This formulation of course misses the generalization that the identity of coronal and manner-of-articulation features is central to the rule. I shall argue that the familiar English plural/past tense rule is triggered by an OCP violation involving the Coronal node and that English uses epenthesis as the fix-up method. The rule is given in (40), and its effects are shown in (41):

- (40) *Coronal Epenthesis*
 Domain: Coda
 Tier: (i) Strident
 (ii) Continuant
 Trigger:
 Change: Insert



Four remarks are in order concerning the formulations in (40) and (41). First, the rule applies only to coronals that agree in continuancy and stridency. I have suggested in section 5.3 on Chumash that stridency is in fact a Coronal feature, since it is normally relevant only for coronals. Continuancy, of course, is not a Coronal feature, and yet it is apparently involved, since nonstrident fricative-stop sequences like *wreathed* do not undergo the rule. For this reason the rule must have a rather complicated Tier specification: it may be that a better understanding of the relationship between Coronal, strident, and continuant will allow for a simpler statement here, making it possible to exclude more than one Tier specification in a rule (since otherwise the restriction to constituents can be circumvented). This problem arises, however, in any attempt to understand the English plural within a restrictive theory.

Second, the insertion must be of an element high enough in the feature structure to intervene between both Manner and Place features—that is, a Supralaryngeal or Root node. This therefore need not be specified in the rule. Third, as pointed out to me by a reviewer, specifying the Domain as the coda correctly predicts that only an insertion that results in the two elements no longer being in the coda will suffice; this means that the inserted slot must be a nucleus, thus making the first C an onset. Fourth, nasal-stop sequences like *pinned* do not undergo the rule, nor do other sonorants in other contexts, such as *-ly* suffixation: *wholly*, not *whol[ə]ly*. I assume that this follows from the fact

that stridency is almost certainly unspecified for sonorants, and they therefore cannot participate in a rule triggered by stridency sequences.

In summary, Epenthesis separates a particular kind of sequence of coronals; we shall see that other sequences are treated differently.

5.5.2. *-ion and -ive Allomorphy.* Turning now to other evidence for OCP effects among coronals in English, let us look at the different allomorphs of *-ion* and *-ive*, shown in (42). The analysis that follows differs somewhat from that of Yip (1987), but the reader is referred there for further details.

(42) a.	prescribe	prescription	prescriptive
	deduce	deduction	deductive
	resume	resumption	resumptive
b.	complete	completion	completive
	deride	derision	derisive
	promote	promotion	promotive
c.	compete	competition	competitive
	add	addition	additive
	define	definition	definitive

Aronoff (1976) points out that noncoronal roots take *-tion* (42a) and coronal roots either *-ion* (42b) or *-ition* (42c). Suppose that the underlying form of the suffix is *-tion*. After noncoronals this surfaces unchanged, giving the forms in (42a); but after coronals an OCP violation results: a sequence of coronal segments. A subset of these roots is marked for a special degemination rule to remove the violation. This gives the forms in (42b). (The morpheme *-ate* is lexically marked for this rule.) If a coronal final root is not so marked, the OCP violation must be removed in some other way; Epenthesis then applies, giving the forms in (42c).

There is an unexplained problem here, though. In the inflectional cases discussed earlier the OCP holds only over coronals that agree in stridency (and continuancy). In these cases, however, any two coronals appear to constitute an OCP violation, so that Epenthesis applies in forms like *definition*, *composition* (contrast these with the failure of Epenthesis in the preterite forms *defined*, *composed*). The *-ion* suffixes are level 1 (witness the fact that they affect stress), whereas the inflectional suffixes are level 2. It may be, then, that at level 1 the OCP holds on all coronal sequences, whereas at level 2 it holds only on a subset that share the same Manner features. I leave this matter for further investigation, but obviously it is extremely important to understand whether the domain of the OCP can change during a derivation, as the English facts suggest, and if so in exactly what ways.²⁰

5.5.3. *Coronal Assimilation.* A third piece of evidence for coronal effects in English is taken from Clements (1985) and Sagey (1986, 135). English exhibits a rather general

²⁰ Hayes (1986b) has argued that the composition of tiers can change during the course of a derivation; perhaps this is such a case.

process that assimilates the first of two coronals to a following coronal in anteriority and distributedness. The data are given in (43):

(43)	/t/	/d/	/n/
-θ	eighth	hundredth	tenth
-š,ž	white shoes	red shoes	inch, hinge, insure, enjoy
-r	tree	dream	enroll

Only [-continuant] coronals undergo the rule, and this automatically excludes the [-anterior] sounds, since there are no such sounds in English whose right edge is [-continuant]. The rule is given in (44):

- (44) *Coronal Assimilation*
 Domain: Phrase
 Tier: Coronal
 Trigger:
 Change: Delete first, if [-continuant]

Subsequent spreading either of Coronal or of Place gives the assimilation. The [-continuant] condition is mysterious, and possibly wrong at least for lexical applications of the rule: /s + θ/ does not arise, and /s + r/ clusters may in fact undergo the rule if one accepts that surface [šr] comes from underlying /sr/. (See Halle and Vergnaud (1979).)

5.5.4. *ad- and ab- Allomorphy.* One more piece of evidence suggests that English pays close attention to OCP violations on the Coronal tier. It is drawn from level 1 morphology and is of limited scope, but I include it here for completeness. There are two prefixes whose final consonant assimilates to the first consonant of the root if they agree in coronality (Chomsky and Halle (1968, 222)). The underlying form of the prefixes can be detected from /h/-initial and unassimilated forms, and the data are given in (45):

(45)	[+cor]		[-cor]		
	<i>ad-</i>	<i>sus-</i>	<i>ab-</i>	<i>sub-</i>	
	adhere		abhor		
	[-cor]	admire	suspect	appear	suffix
	[+cor]	assist	surreptitious	abduce	subsist

Now consider this within the theory outlined in this article. The prefixes end in consonants specified for coronality. When they are adjacent to another segment with the same specification, an OCP violation results, and in this instance the prefix specification is deleted and the root specification then spreads (spreading is clearly present at level 1, as evidenced by the assimilation in the prefix *in-*). If the two consonants have different specifications for coronality, nothing happens. Note also that manner of articulation is irrelevant here, supporting the view that at level 1 simple coronal sequences constitute OCP violations irrespective of manner.

Noncoronals also undergo this rule, as shown by forms such as *appear*, *support*. In the feature theory assumed here [-coronal] does not exist, so these data pose some-

thing of a problem for Sagey's proposal—a problem I shall not attempt to resolve here. The main point of this section remains: English shows several different phenomena that point to the existence of OCP activity on the Coronal tier. (See also section 2.3.) English usually chooses to undo such violations via Epenthesis, as typified by the plural and past tense forms, but Deletion, with or without spreading, is also used. Without appeal to the OCP the variety of different phenomena that involve identity of the feature [coronal] would remain mysterious.

5.6. *Movement Away: Clash Resolution*

This section takes a very familiar phenomenon, stress clash, and looks at it from a somewhat different angle. The representation of stress used here is that of Prince (1983), in which relative levels of stress are denoted by the relative height of columns in a stress grid. Prince argues that stress grids are built up by means of a Perfect Grid rule that assigns marks to alternate grid positions to create an alternating pattern.²¹ Grid construction is blocked if it would create a clash, a property Prince calls Clash Avoidance.²² The blocking grid mark can arise from lexical stress or the presence of a heavy syllable. Instead of (46a) we get (46b):

- (46)
- | | | | | | | | |
|-----------------|----|----|---|---|---|---|---|
| x | a. | *x | x | x | x | x | x |
| x x x x x x x x | → | x | x | x | x | x | x |
| | | b. | x | x | x | x | x |
| | → | x | x | x | x | x | x |

I suggest that this is not a phenomenon restricted to stress, but rather an example of a much more general principle at work, namely, the OCP. My claim is that the OCP may not be restricted to feature bundles as such but may also govern other formal entities such as the relative prominence markings that constitute a stress grid.²³ An anonymous reviewer has pointed out that if the grid is thought of autosegmentally, as Prince (1983, 48) suggests, then OCP properties are to be expected. Under this view, Clash Avoidance becomes another instance of the blocking effect of the OCP demonstrated by McCarthy in the case of antigemination, since stress clash would be an OCP violation—a sort of “geminate stress.”

The OCP enforces alternating patterns, and the quintessential example of an alternating pattern is the Perfect Grid. In fact, it is possible to go even further and say that the Perfect Grid itself does not have to be laid down in Universal Grammar: it is the

²¹ Even if stress trees are also required, the arguments here would still hold of the grids, as far as I can see.

²² Clash Avoidance is not always observed, suggesting that the OCP is not an absolute blocker in stress systems. Why this should be is unclear.

²³ One indication that this might be so is that accentual languages are usually limited to one accent (= grid mark) per morpheme, as might be expected if the OCP applied as an MSC to grid marks. Concatenation of accents usually results in deletion of one accent, as in Slavic. Unlike features, grid marks are always on their own tier and therefore subject to the OCP.

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regard to take a brief look at some data from Italian from an article by Nespor and Vogel (1979), in which they show that although all dialects of Italian object to stress clashes (observe the OCP with respect to stress), they choose different ways of removing the clashes. One dialect uses movement, like English, but another uses a lengthening process called Raddoppiamento Sintattico so as to space the stresses further apart. The data are given in (49):

		<i>Dialect A</i>		<i>Dialect B</i>
(49)	metá tórta	→ mèta tórta	or	metà t:órta
	cittá spórca	→ citta spórca	or	città: spórca

In Dialect A a rule like the English Rhythm Rule applies, separating the two stresses. In Dialect B the stresses do not move, but the first syllable is lengthened either by lengthening the following consonant so as to close the syllable or, if that consonant is part of a cluster, by lengthening the vowel. This apparently increases the distance between the stresses sufficiently to ameliorate the clash. Nespor and Vogel call this the Sufficient Phonological Distance (SPD), and it could be analyzed as inserting an additional position in the grid, thus separating the two stresses.

In this section I have argued that three properties of stress systems—the Perfect Grid, Clash Avoidance, and Clash Resolution—can be viewed as stemming from the OCP acting on metrical entities. The OCP enforces alternating patterns—hence the Perfect Grid. It can act as a rule blocker—hence Clash Avoidance—and it can act as a rule trigger—hence the Rhythm Rule in English and Raddoppiamento Sintattico in Italian.

This concludes section 5, in which I have shown evidence that the OCP is active during the derivation as a rule trigger as well as a rule blocker. In each case attributing the conditioning of the rule to the OCP captures a generalization missed in the traditional statement of the rule: the condition that two of the segments involved share one or more feature values. The OCP also ties together several otherwise distinct phenomena in a variety of cases: the MSC, historical dissimilation, and synchronic dissimilation in Cantonese; general coronal assimilation, plural and past tense epenthesis, *-ion* allomorphy, and *aC-* prefix assimilation in English; and the Perfect Grid, Clash Avoidance, and Clash Resolution in stress systems. I now turn to a perhaps less obvious OCP effect: the conditioning of the mode of application of an otherwise ambiguous rule.

6. The OCP as a Conditioner of Choice of Target

There are languages in which a single rule appears to both precede and follow another rule, resulting in an ordering paradox. One such case is Vowel Deletion (Truncation) in Kasem (Phelps (1975), Halle (1978)), which bleeds Metathesis in some cases and is fed by it in others. I shall propose a different analysis in which there is a single Vowel Deletion rule whose target is incompletely specified. The choice of target is determined by the OCP, in that OCP violations must be removed if present and also cannot be created. Metathesis is no longer required; hence, no ordering problems arise. Here the OCP acts as a rule conditioner as well as a rule trigger.

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The analysis that gives rise to the ordering paradox is from Halle (1978). Kasem nominals fall into various classes that form their singulars and plurals with different suffixes. Some examples are given in (50):

- (50) Class C: bakada bakadi 'boy(s)'
 fala fali 'white man'
 Class A: lodu loda 'builder'
 valu vala 'farmer'

If the stem-final and suffixal vowels are identical, one vowel deletes:

- (51) tu + u → tu (Plural: tua > twa)
 kuu + u → kuu (Plural: kuudu)
 pi + i → pi (Sing: pia)

Assuming that this is triggered by the OCP, the rule itself can be stated as "Delete second matrix," with no spreading. The condition that the two vowels be identical is a result of the OCP and need not be encoded in the rule.

This rule interacts with a rule of Metathesis that interchanges the first two of a sequence of three vowels. In order to derive the correct forms, Halle is forced either to put a condition on Metathesis, blocking it from applying when the last two vowels are identical, or to allow Truncation to apply whenever its conditions are met. He picks the latter course and gives the derivations in (52):

- (52)
- | | | | | |
|-------------|---------|---------|-----------|-----------|
| | pia + a | pia + i | bukau + u | bukau + a |
| Truncation | pia | N/A | bukau | N/A |
| Metathesis | — | pai + i | — | bukua + a |
| Truncation | — | pai | — | bukua |
| Other rules | — | pe | buko | bukwa |

(The "other rules" are contraction of *ai* > *e*, contraction of *au* > *o*, and Glide Formation.) Notice two things about (52). First, if Metathesis follows Tier Conflation, then it *creates* an OCP violation in *pia + i* → *pai + i*. This should be impossible if we accept McCarthy's arguments. Second, the output of Truncation and Metathesis has two properties: (i) the suffixal vowel is always unaffected, and (ii) the two remaining vowels are always different. The second property looks remarkably like an OCP effect again: the rules cannot apply so as to create a sequence of two identical vowels, in other words, an OCP violation. I suggest that Kasem has a single rule simplifying three-vowel sequences:

- (53) *Kasem Vowel Reduction*
 V V → V / ___ V

Note that the V slot and all its features are lost. This rule is subject to the OCP, and this will have two effects. If the second and third vowels are identical, then of course one of them must delete. If the first and third vowels are identical, the intervening vowel cannot delete, since this would create an OCP violation; therefore, the first vowel deletes.

This is shown in (54):

- (54) $pia + a \rightarrow pi + a$ (* $pa + a$)
 $pia + i \rightarrow pa + i$ (* $pi + i$)

The OCP thus forces a unique interpretation on the ambiguous rule (54). If this is correct, we have solved both problems mentioned above: Metathesis does not exist, so (i) there is no ordering problem and (ii) it does not create OCP violations.

There is one complication for this analysis, namely, the group of forms that Halle used to motivate Metathesis in the first place. Consider the data in (55):

- (55) $koga$ (< $kaug + a$) kwe (< $kaug + i$)
 $coga$ (< $caug + a$) cwe (< $caug + i$)

Halle argues that [o] is not an underlying vowel of Kasem but is derived by contraction from /au/. In the plural forms the velar elides (by a morphologically conditioned rule), creating a three-vowel sequence $au + i$. Since all three vowels are different, the OCP has no obvious bearing on this case, and my analysis makes no predictions. Halle argues that the presence of the glide shows that Metathesis has taken place, giving the following derivation:

- (56)
- | | |
|---------------------------|------------|
| | $kaug + i$ |
| $g \rightarrow \emptyset$ | $kau + i$ |
| Metathesis | $kua + i$ |
| Contraction | kue |
| Glide Formation | kwe |

Since I have argued that Metathesis does not exist, it is incumbent on me to provide another source for these plurals (the singulars do not present a problem). The reason for proposing Metathesis in (56) is that the singular vowel [o] is supposed to come from /au/, but the plural [we] must come from /ua/ (+ /i/). I would like to suggest that the underlying representation is in fact an unordered complex segment in the sense of Sagey (1986), neither /ua/ nor /au/, and that no Metathesis is needed for the plural forms. The different features of /u/ and /a/, [+back] and [-high], are unordered and associated with a single V slot, as shown in (57):²⁵

- (57)
- | | | | | |
|---|-----|---|---|---|
| C | V | C | + | V |
| | | | | |
| k | u a | g | | a |

The interpretation of such a doubly linked vowel in Kasem is a "compromise," in this

²⁵ Sagey (1986) argues cogently that complex consonants involve specification of more than one articulator node. The same analysis can be extended to vowels. Suppose that Kasem has the following underspecified vowels: /a/ [-high], /i/ [-back], /u/ [-low]. Then /ai/ will be [-high, -back], [e], and /au/ will be [-high, -low], [o].

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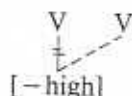
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case [o]. In the plural the situation is as follows:

$$(58) \begin{array}{c} C \quad V \quad + \quad V \\ | \quad \wedge \quad | \\ k \quad u \quad a \quad i \end{array}$$

Vowel Reduction does not apply because there are only two V slots, not three, but the output shows contraction of the last two vowels, not the first two. I thus assume the existence of a flop rule, given in (59), resulting in derivations like (60):

(59) *Flop Rule*



$$(60) \begin{array}{c} C \quad V \quad V \\ | \quad \wedge \quad | \\ k \quad u \quad a \quad i \end{array} \xrightarrow[\text{Rule}]{\text{Flop}} \begin{array}{c} C \quad V \quad V \\ | \quad | \quad \wedge \\ k \quad u \quad a \quad i \end{array} \xrightarrow[\text{Formation}]{\text{Glide}} \begin{array}{c} C \quad C \quad V \\ | \quad | \quad \wedge \\ k \quad u \quad a \quad i \end{array}$$

Under this view, contraction happens when two vowels are associated with the same slot either underlyingly or as a result of a Flop Rule, and when the second vowel is unspecified for height. The resulting V slot surfaces as the compromise [e]. For an analysis of Chinese in which V slots associated with two vowels result in a compromise vowel, see E. Pulleyblank (1986).

The failure of Vowel Reduction (53) to apply in forms like (58) is presumably attributable to the presence of only two V slots; the rule specifies three. Another form sheds further light on the situation. Consider (61a), whose plural is shown in (61b):

(61) a. *yua ywe* 'hair'

$$b. \begin{array}{c} C \quad V \quad V \quad + \quad V \\ | \quad | \quad | \quad | \\ y \quad u \quad a \quad i \end{array}$$

The singular is apparently derived from /yua + a/, with Vowel Reduction giving /yua/. The plural can be derived from /yua + i/, with the Flop Rule, Contraction, and Glide Formation. But why does Vowel Reduction (53) not apply here? The root must have two nuclear slots, in contrast to the single slot in *koga*, because Contraction does not apply in the singular. There are thus three vowel slots and three melodic elements. However, there are no OCP violations, nor could any be produced by the rule. It appears, then, that in these circumstances Vowel Reduction fails to apply. Notice, however, that there is no Metathesis in this case, suggesting strongly that Metathesis does not exist.²⁶

²⁶ The forms *liledu* - *lilio* and *diga* - *dii* present problems. The derivation *dig + i* → *dii* should be impossible because if McCarthy is right *g* → *β* should be blocked in this instance because it produces an OCP violation. Counterparts are found in other languages: in Finnish lenition creates OCP violations in forms like *rauha + ta* → *rauhaa*, although if the first vowel is long the rule is blocked: *maa + ta* → **maa + a*, but *maata*. I am indebted to Gary Milsark for drawing this to my attention.

The form *liledu* - *lilio*, from /lilai/, is interesting. The final rhyme must have a single slot associated with

The failure of Vowel Reduction (53) to apply unless two identical vowels are present is interesting, given that the vowels need not be adjacent. The situation is very reminiscent of the cooccurrence restrictions on homorganic consonants in Semitic roots (McCarthy (1986b)). It appears that a Kasem rhyme may not contain two identical vowels, or in other words that the two [-back] instances of /i/ in /iai/ are in fact adjacent on the Dorsal tier. If all three vowels are different, as in /uai/ and /iau/, the rule fails to apply. This is strong evidence in favor of the claim that rules cannot apply unless triggered, so that in the absence of a trigger specified by the rule itself an external trigger—the OCP—is necessary. It is of course logically possible that other types of external trigger could exist, and Calabrese (1986) argues for just such a case in Italian dialects. In his analysis there are gaps in the phoneme inventory that require the existence of filters of the general type [$*\alpha F, \beta G$]. These filters then trigger the operation of a variety of rules.

I have argued here that the OCP shows a different kind of influence on derivations: an ability to disambiguate an otherwise ambiguous rule.

7. The OCP and the Form of Rules

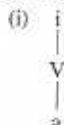
In this final section I shall briefly point out that the form of phonological rules themselves is restricted in several ways by the OCP.

7.1. Assimilation

Two methods have been available to characterize assimilation. One, the more traditional, has been a feature-changing rule, and the other, thanks to nonlinear phonology, has been spreading. Since it was noticed that the output of assimilation typically displays geminate-like properties, spreading has been largely assumed to be the appropriate way to state assimilation rules. The OCP, however, requires that it be the *only* way to state such rules, since the output of a feature-changing rule like (62) violates the OCP and therefore is blocked:

$$(62) \quad -\alpha F \rightarrow \alpha F / \text{---} \alpha F$$

the sequence /ai/, giving [e] in the singular. In the plural we have the suffix -u, giving a total of two V slots but three melodic elements. With only two V slots Vowel Reduction (53) cannot take place, but the Flop Rule that produces contraction, as in (60), must have taken place, since we get [o] from /au/. How can the /a/ flop to the right if it is the first vowel in the root melody? I suggest that the correct representation avoids assigning a sequential order to the two melodies in the root: something like (i) may be closer to the mark:



The low vowel flops over because there is an available space on the suffix slot (whereas the high vowel space is filled).

The OCP thus predicts, rightly I think, that no language could ever have an assimilation rule of the feature-changing type whose output failed to behave like a geminate. See also Hyman and Pulleyblank (1987) for further discussion on this point.

7.2. Syllabic Insertion Rules

Languages often have rules that insert skeletal slots (*X* slots), and these rules tend to preserve an alternating CVCVCV pattern. Levin (1985, 330) proposes an output condition on *X*-tier transformations given in (63) (simplified for present purposes):

- (63) **X* *X* **X'* *X'*
 (where *X* is a nucleus (vowel slot) and *X'* is a nonnucleus (*C* slot))

This output condition can be seen as no more than the OCP applying on the skeletal tier and therefore need not be included separately as part of Universal Grammar. A particular instance of a skeletal rule of this kind will serve to illustrate the situation.

Axininca Campa (Payne (1981), Yip (1983)) has two rules that insert *V* and *C* slots in the following environments:

- (64) $\emptyset \rightarrow V / C]_{vb} \text{ — } C$
 $\emptyset \rightarrow C / V]_{vb} \text{ — } V$

The *C* slot eventually surfaces as /t/, and the *V* slot usually surfaces as /a/. Given the OCP, and its particular instantiation as (63), this can be generalized to a single rule:

- (65) $\emptyset \rightarrow X / X]_{vb} \text{ — } X$

This rule, reworded along the lines suggested earlier, consists of the following:

- (66) *Slot Insertion*
 Domain: Right edge of verb stem
 Tier: *X* tier
 Trigger:
 Change: Insert slot

This concludes the section on the form of rules and the OCP.

8. Conclusion

I have argued here that the Obligatory Contour Principle has widespread effects during the phonology, so that it acts as an MSC, rule blocker, rule trigger, constraint on the mode of operation of an ambiguous rule, and constraint on the form of possible rules. I have illustrated my case for the latter three effects with examples of each predicted kind of action, drawn from a variety of languages. Once the OCP is understood to act in this way, a large class of rules—those in which the structural description requires identity of some feature or features—becomes greatly simplified so that they are very highly valued by the grammar. Under the standard notation for rules of this type the

identity of the features was coincidental, and they were no more natural than many other highly implausible rules. The OCP, clearly attested as an MSC and, more recently, as rule blocker, can now be seen as a kind of omnipresent well-formedness filter, with obvious parallels in the filters of syntactic theory.

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