THE OCP IN FUNCTIONAL PHONOLOGY[1]

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Abstract. *Though seemingly a good candidate for a universal output-oriented constraint, the OCP does not occur as a constraint in the production grammar. Instead, it handles, in interaction with the No-Crossing Constraint, the correspondence between acoustic cues and perceptual feature values in the perception grammar. Because faithfulness constraints use the perception grammar to evaluate the similarity between the perceptual specification and the perceptual output in the production grammar, the OCP does influence the evaluation of candidates in the production grammar. As a result, adjacent identical elements are avoided because they constitute* PARSE *violations. Dissimilation at a distance, by contrast, is due to a constraint against the repetition of articulatory gestures.*

In this paper and in Boersma 1998a, I point out the advantages of distinguishing between articulatory and perceptual features in autosegmental phonology. According to McCarthy (1988), the only phonological processes that can be accepted as primitives in autosegmental phonology, are ***spreading***, ***deletion***, and the ***obligatory contour principle*** (OCP). While Boersma 1998a centres on spreading, the current paper will tackle the OCP.

McCarthy (1986) expresses the Obligatory Contour Principle (OCP) in its naked form as follows:

> “adjacent identical elements are forbidden”

As we will see, many phenomena have been ascribed to this principle.

1 Functional interpretation of the OCP

From a functional standpoint, the OCP is not a single primitive principle, but branches into two fundamentally different ones. Furthermore, one of these two principles is naturally embedded in a set of constraints on simultaneous and sequential combinations of gestures and perceptual features.

1.1 Articulatory and perceptual motivations

If we distinguish between articulatory and perceptual phenomena, the OCP branches into two principles.

The first is a general principle of human perception, not confined to phonology. In designing a country map of Europe, the cartographer can choose to fill in the countries with the minimal number of four colours that are needed to give every pair of adjacent countries different colours. If she decided to paint both the Netherlands and Belgium red,

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[1] This paper is chapter 18 of Boersma (1998b), which is available from the author (http://fonsg3.hum.uva.nl/paul/) or from the publisher (http://www.hagpub.com).

the reader of the map would not be able to identify them as separate countries; thus, in cartography, adjacent identically coloured countries are avoided.

Likewise, if a morph ending in /-m/ is concatenated with a morph starting with /m-/, the usual timing of syllable-crossing clusters will result in the long consonant [-mː-]. The perceptual identity of one of its constituents is therefore lost, violating featural faithfulness. Some of the information about the existence of two morphemes is kept in the timing, but if the language is adverse to geminates, it may just end up with [-m-], violating some more faithfulness.

The problem of the long perceptually homogeneous sound can be levied by inserting a pause between the two consonants (i.e., drawing a black border between the Netherlands and Belgium): giving [[-m_m-]]. This violates a FILL (pause) constraint: a pause can be perceived as a phrase boundary. Another strategy would be to insert a segment (declaring the independence of the southern provinces of the Netherlands, and painting them blue), which will give [-məm-] or so: another FILL violation. Language-specific rankings of all the faithfulness constraints involved will determine the result.

The perceptual nature of this first functional correlate of the OCP is shown by the rules of vowel insertion in English, which are hard to capture with generalizations over single tiers in feature geometry. Thus, the insertion of /ɪ/ before the morpheme /-z/ occurs in *bridges* but not in *tents*, exactly because [dʒz] would contain a perceptually unclear boundary (The Netherlands in red, Belgium in purple), and [nts] would not; likewise, the insertion of /ɪ/ before the morpheme /-d/ occurs in *melted* but not in *canned*, because the boundary would be lost in [ltː] but not (or less so) in [nd].

The second functional correlate of the OCP is simply the tendency not to repeat the same articulatory gesture: an articulatory *REPEAT constraint. The features involved in this constraint are arguably of an articulatory nature: the Japanese constraint against two separate voiced obstruents within a morpheme obviously targets the articulatory gesture needed for the voicing of obstruents, not the perceptual voicing feature, which would also apply to sonorants. A clear difference with the first principle is exhibited by a morpheme-structure constraint in Arabic, which does not allow two labial consonants within a root; apart from disallowing two appearances of /b/, it does not even allow /m/ and /b/ to appear together. This generalization over plosives and nasals is typical of the articulatory labial gesture, which does not care whether the nasopharyngeal port is open or not, whereas the divergent behaviour of plosives and nasals in *melted* versus *canned* is exactly what is expected from a perceptually conditioned phenomenon.

The predicted correlations between near OCP effects and faithfulness constraints, and between distant OCP effects and articulatory constraints, are verified in this paper.

1.2 Simultaneous and sequential combinations of features

I will identify the “perceptual” OCP as one of the four constraint clans that handle ***combinations*** of articulatory gestures or perceptual features. In a functional theory of phonology (Boersma 1998b), we express articulatory implementations in articulatory features (gestures) *or their combinations*, and we express perceivable sounds in perceptual features *or their combinations*.

Articulatory constraints on combinations of gestures.
From general properties of the acquisition of human motor behaviour (namely, the ability to group simultaneous or sequential gestures into a more abstract coordination or motor program), we can posit the unity of often-used coordinated gestures (like the lip and tongue body gestures in [u], in a language where this sound is common), and the unity of common sequences of gestures (like the lip closing and opening gestures in [apa], in a language where [p] often occurs intervocalically), which leads to assuming separate constraints for these more abstract articulations:

*COORD (a_1: g_1; a_2: g_2 / ...): “do not combine the gesture g_1 on the articulator a_1 with the gesture g_2 on the articulator a_2.”
*SEQ (a_1: g_1; a_2: g_2 / ...): “do not follow the gesture g_1 on the articulator a_1 with a gesture g_2 on the articulator a_2.”

Faithfulness constraints on combinations of perceptual features.
From general properties of the acquisition of human perception (namely, the ability to group simultaneous or sequential percepts into a more abstract representation), we can posit the unity of often-heard simultaneous features (like labiality and nasality in [m], in a language where this sound is common), and the unity of common sequences of features (like the nasal murmur, the silence, and the explosive burst in [ampa], in a language where [mp] often occur in sequence), which leads to assuming separate faithfulness and correspondence constraints for these more abstract percepts:

*REPLACEPATH ($f \times g$: $x \times z$, $y \times w$): “do not replace the values x and z on the combined perceptual tiers f and g with the different combination y and w.” For instance, depending on the language, a surfacing of /n/ as /m/ may involve a violation of *REPLACE (place: cor, lab / nas) or a violation of *REPLACEPATH (place × nas: cor × +nas, lab × +nas).
OCP (f: x; $q_1 \mid m \mid q_2$): “A sequence of acoustic cues q_1, q_2 with intervening material m is heard as a single value x on the perceptual tier f.”

The OCP is just one of the four combination constraints. It belongs in the ***perception grammar*** (Boersma 1998b: ch. 6, 8, 15) since it handles the categorization of acoustic input into perceptual features. As such, it also plays a crucial role in featural correspondence in the ***production grammar*** (Boersma 1998b: §12.3).

2 History of the OCP

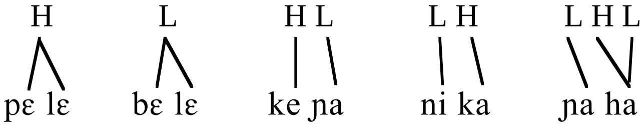
In order to be able to defend the descriptive adequacy of a functional account of the OCP, we have to investigate first the various interpretations it has suffered throughout the years, and the types of phenomena it has been invoked to explain.

2.1 The original OCP

The first expression of the OCP is commonly attributed to Leben (1973). In his defence of ***suprasegmental phonology***, he demonstrated that tone features and nasality show suprasegmental behaviour in several languages. For example, in Mende, mono- and bisyllabic monomorphemic nouns have the following possible tone sequences (H = high, L = low, HL = falling, etc.):

1. Nouns of one syllable have H (/kɔ́/ ‘war’), L (/kpà/ ‘debt’), HL (/mbû/ ‘owl’), LH (/mbǎ/ ‘rice’), or LHL (/mba᷈/ ‘companion’), but not HLH.
2. Nouns with two syllables have H-H (/pɛ́lɛ́/ ‘house’), L-L (/bɛ̀lɛ̀/ ‘trousers’), H-L (/kéɲà/ ‘uncle’), L-H (/nìká/ ‘cow’, or L-HL (/ɲàhâ/ ‘woman’).

The five tone sequences for the bisyllabic nouns can be seen to be equal to those of the monosyllabic nouns, if we represent Mende tone in a suprasegmental way:



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The generalization is that Mende has a morpheme structure constraint that allows only tautomorphemic tone sequences H, L, HL, LH, and LHL.

Leben’s analysis assumes that the segmental and suprasegmental information is specified in the lexicon as two independent sequences, and a phonological rule maps the tones to the syllables. This rule assigns tone to syllables in a one-to-one fashion from left to right. If there are more syllables than tones, the last tone spreads through the remaining syllables.

Thus, Mende provides evidence for the fact that an apparent sequence of high tones on adjacent syllables should sometimes be viewed as only one H. Leben (1973) does not suggest yet, however, that tautomorphemic HH sequences are universally impossible; the strongest statement in that direction is his assertion (p. 94) that for Mende, “the distinction between HLL and HHL is representable in McCawley’s notation, while in suprasegmental notation, both sequences reduce to HL”.

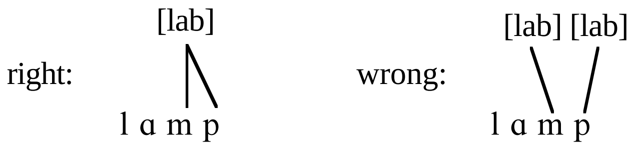
2.2 Morpheme-structure interpretation of the OCP

Goldsmith’s (1976) ***autosegmental phonology*** changed the language and the scope of the suprasegmental approach. From then on, Mende was said to have independent tonal and segmental ***tiers***, which were ***linked*** with ***association lines*** (visible in the above representation of bisyllabic nouns). Goldsmith made Leben’s tacit assumption explicit, coining it the ***Obligatory Contour Principle***: “At the melodic level of the grammar, any two adjacent tonemes must be distinct. Thus HHL is not a possible melodic pattern; it automatically simplifies to HL” (Goldsmith then goes on to reject the OCP).

In autosegmental theory, this principle acts as a condition on representations, valid within any tier. On the root-node tier, the interpretation is that geminate consonants and long vowels should be represented as e.g.

(2)

In these figures, association lines link the root nodes /b/ and /e/ to the CV skeleton (or ***timing tier***). On the labial tier, the OCP ensures that the last two segments of /lɑmp/ share one [labial] specification, and not two:



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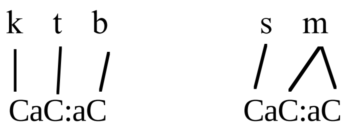
The functional interpretation of these ideas is that /bː/ and /mp/ are both implemented with a single gesture of the lips, and that in /eː/, the tongue and jaw are held in one position.

As a universal condition on phonological representations, the OCP helps us to express constraints on morpheme structure. For instance, if a language has no geminate consonants or long vowels, these constraints can be expressed as the following filters:

(4)

With this interpretation, the OCP seems to be satisfied in most cases in most languages. Exceptions, e.g., cases where it is favourable to represent a /mp/ sequence as having two separate [labial] specifications, are known as ***OCP violations*** (we can now note that the OCP has long been the only violable constraint in generative phonology). Within morphemes, the OCP is thought to be universal, and this can be tested by investigating the scope of phonological rules.

A good example is found in the root structure of Semitic languages. McCarthy (1986) formulates the OCP as follows: “At the melodic level, adjacent identical elements are forbidden.” McCarthy restricts himself to absolute identity of segments, and argues that in Semitic languages, consonants and vowels are on different tiers, where the consonant sequence can be identified with the lexical root. For instance, in Bedouin Hijazi Arabic (McCarthy 1982), /katːab/ ‘he wrote’ clearly has the root /ktb/ ‘write’, which is mapped onto the pattern /CaCːaC/ ‘(past 3 sg.)’. Likewise, /samːam/ ‘he poisoned’ seems derived from the root */smm/, but this is impossible according to the OCP, because two identical /m/ would be adjacent: the root must be /sm/, and the /m/ is spread to the last consonant (we already inserted the vowels into the template):



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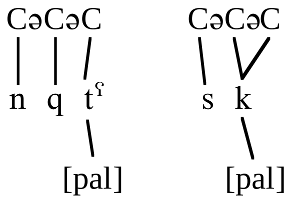
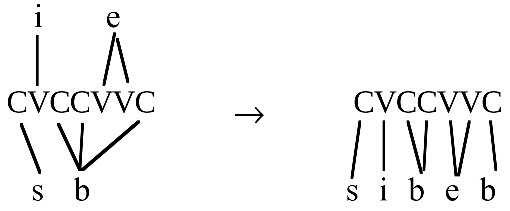
This analysis is corroborated by many facts, including from a language game (McCarthy 1982), which freely commutes the root consonants and leaves the pattern intact, so that /katːab/ may become /batːak/, /kabːat/, /takːab/, /bakːat/, or /tabːak/. By contrast, /samːam/ ‘is mapped to /masːas/ only, which is exactly what we expect if the root is /sm/ and the game works directly on the root. Apparently, the root is indeed /sm/. Because *all* /C_1aC_2ːaC_2/ words in Arabic behave in the same way as /samːam/, we can see that their roots must be /C_1C_2/; thus, all Arabic roots obey the OCP and Arabic cannot distinguish between /sm/-like and /smm/-like roots.

If Semitic roots must always be analysed as satisfying the OCP on the consonantal level, we can expect morphological and phonological rules to work on the two reflexes of the second consonant of biconsonantal roots. McCarthy provides the following example. In Chaha, the feminine form of the imperative is made by applying palatalization to the last coronal or velar consonant in the root. Thus, /nəqətˤ/ ‘kick’ becomes /nəqətˤʲ/. The biconsonantal /səkək/ ‘plant in the ground’, however, is taken to /səkʲəkʲ/. Apparently, for this morphological operation, the two /k/ act as a single consonant:



(6)

Most *phonological* rules, however, do not show this behaviour. For instance, Tiberian Hebrew has a rule of postvocalic spirantization, which does not apply to geminates. Still, this rule takes /sibːeːb/ ‘he surrounded’, from the root /sb/, to /sibːeːβ/, changing only a part of the alleged single consonant. The solution is that this rule works on a form that is created by the ***conflation*** of the consonantal and vocalic tiers. Thus, /sb/ + /CiCːeːC/ is first converted to /sibːeːb/ in a process called ***Tier Conflation*** (a generalization of the process of ***Bracket Erasure*** known from concatenative morphology), which is applied after each stratum in the lexical phonology:



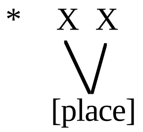
(7)

In /sibːeːb/, the two /b/ are no longer adjacent, and postvocalic spirantization will affect the last /b/; the branching /b/ in the geminate is still one consonant, because we do not get */siβbeːβ/. In the Chaha example, we saw that morphological palatalization occurred *before* the conflation of the root and pattern tiers.

As Odden (1988) points out, it remains a question why many phonological rules are never seen to precede Tier Conflation. For example, McCarthy (1986) notes that ***geminate integrity*** (the universal failure of phonological rules to target only one of the supposed members of a geminate) is only valid for ***surface*** tautomorphemic geminates.

McCarthy (1988) generalizes the OCP to all the tiers that are known from the theories of ***feature geometry***. In part, this move adapted the OCP theory to a criticism by Odden (1988) and Yip (1988), namely that sequences of homorganic consonants, like /bm/, are ruled out in Semitic roots. If a separate morpheme structure constraint would be needed to capture this fact, this constraint would encompass the OCP, so the OCP would be superfluous as far as morpheme structure is concerned. To save the OCP, McCarthy extended it to include the labial tier and other articulator tiers. Thus, the root /btm/ is ruled out because the labial specifications of /b/ and /m/ are adjacent on the [labial] tier.

Suddenly, however, the near-universal OCP, which might be parametrized but whose "default value is *on*" (McCarthy 1986), was replaced by a highly language-dependent tendency-like constraint, whose default value must be *off*; most languages, after all, do not object to tautomorphemic homorganic consonants like /mb/, because no OCP is violated. Therefore, the OCP is not strong enough to rule out the root /tmb/ all by itself; we must enforce the additional constraint that the place node must not branch:



(in Semitic roots)

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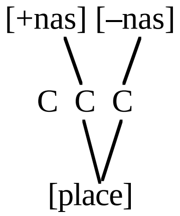
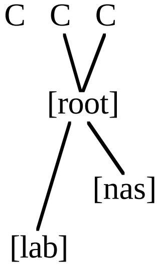
This well-formedness condition would do the job, with the help of the OCP, which universally does not allow separate identical place nodes; the root /btm/ must then be ruled out by the additional constraint that the [labial] node does not branch (since on the place tier, /b/ and /m/ are not adjacent). McCarthy does not state these constraints explicitly, probably because they are not entirely true: for many pairs of consonants, they are only tendencies, i.e. they express markedness criteria. Besides, introducing these non-branching constraints would have to change the formulation for the case of identical segments as well.

To see this, we must consider the interpretation of root-consonant formulas like /ktb/, /sm/, /smm/, and /tmb/. In early generative phonology, symbols like /m/ and /b/ were used to transcribe segments and were to be interpreted as shorthands for complete feature bundles. Since the advent of autosegmental phonology, the interpretation has changed, because some features are shared between adjacent segments. Consider first the interpretation of /tmb/. If it stands for a sequence of three separate complete feature bundles, the OCP is violated. But if it is interpreted in the usual way in which a segmental sequence like /tumb/ is interpreted, namely as



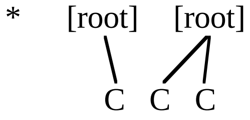
(9)

then the OCP is not violated. An analogous story can be told for the root node: the sequence /smm/ could mean three separate feature bundles, in which case the OCP is violated. However, interpreted in the same way as is usual for /summ/ (though that would be transcribed as /sumː/), the OCP is not violated:



(10)

The fact that we have a separate linear-notational device for branching root nodes (as in /sumː/), and lack one for branching place nodes (or it should be /tum͡b/), cannot be a reason for treating geminates in a different way from homorganic NC clusters. Thus, a grammar for Semitic root consonants must contain a filter that prohibits branching root nodes:



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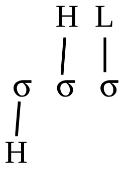
2.3 The OCP in phonological rules

Interesting things may happen when morphological or syntactical operations produce structures that threaten to violate the OCP. For instance, suppose that a morpheme with a H tone is concatenated to a morpheme with a HL contour. Before the morphological operation, the two tone sequences can be thought of as sitting on different tiers, so that the OCP is not violated (McCarthy 1986). Any of the following representations of this situation will do (σ = syllable):

H + HL



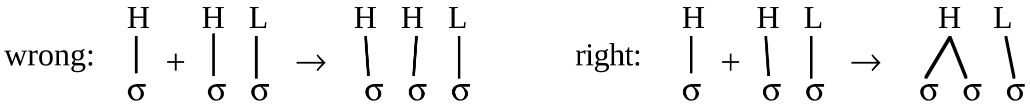
[[H][HL]]

(12)

After the morphological operation, which removes the '+', conflates the two tiers, or erases the inner brackets, a resulting HHL contour would violate the OCP. A number of theories about what happens, have been proposed.

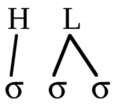
2.4 The fusion interpretation of the OCP

In order to satisfy the OCP, the result of the concatenation H+HL may be a HL contour, with the H doubly connected:



(13)

Evidence for this falling together of the two H tones must come from later phonological rules, which are predicted to treat the resulting single H as one toneme. For instance, if the default left-to-right one-to-one tone-mapping rule applies cyclically to the output of the above morphological operation, the result will be



(14)

which would be a clear proof of the fusion of the two H tones.

Thus, the OCP seems to play an active role in concatenation: it collapses two adjacent identical elements into one. This is the ***fusion*** interpretation of the OCP; it was assumed by Goldsmith (1976) for phonetics and by Leben (1978) for tone.

2.5 Antigemination: the blocking interpretation of the OCP

McCarthy (1986) does not agree with the fusion interpretation of the OCP. He notes that in Afar (Bliese 1981), the stressed suffix /ˈi/ ‘(nom.-gen.)’ takes the stress away from the root, thus creating a situation in which a syncope rule can delete the originally stressed vowel:

ħamˈil ‘swampgrass’ + ˈi → ħamilˈi → ħamlˈi (15)

The fusion interpretation of the OCP would handle a root with two equal consonants in the following way:

miɖˈaɖ ‘fruit’ + ˈi → miɖaɖˈi → *miɖɖˈi → *miɖːˈi (16)

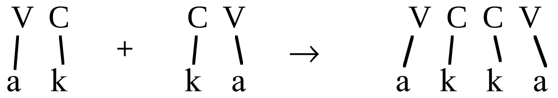
We see that this is a scheme that would *repair* the OCP-violating *miɖɖˈi by fusion, like the tone example above can be interpreted as repairing an offending HHL sequence. But the actual result is /miɖaɖˈi/, not */miɖːˈi/. Apparently, the OCP blocks the syncope rule: the OCP violation is *prevented*, not repaired. This is the ***blocking*** or ***antigemination*** interpretation of the OCP.

McCarthy (1986) is quite explicit about his preference: “I reject the fusion interpretation of the OCP and hold instead to its blocking effect”. The first reason that he mentions is that “we never find application of syncope followed by restructuring of the output”. The second reason deserves to stand out:

> “the idea that universal or language-specific constraints on phonological well-formedness function as negative rather than positive filters is far more typical of the vast majority of uses of constraints in the literature” (McCarthy 1986, p.222)

In this comparison, ***positive filters*** are repair rules: even the OCP can be seen as a *rule* that collapses identical adjacent elements. ***Negative filters***, on the other hand, evaluate the possible output of a rule and are capable of blocking that output. It is crucial that these cases should be seen as blocking of syncope, not of triggering of epenthesis.

What, then, with the simple fusion that is found so often when a morpheme ending in /-ak/ is connected to a morpheme starting with /ka-/? McCarthy (1986) maintains that either of two possibilities arise. The first is:



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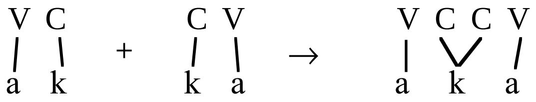
This violates the OCP. However, according to McCarthy, this is not a serious problem, because it “arises from a conflict between the OCP and another universal principle, Tier Conflation”, in which “we are free to dictate priority between the two as we choose”. This formulation suddenly introduces out of nothingness a new device into the repertoire of phonology, namely, the idea of strict ranking of violable constraints. For the moment, McCarthy rejects this idea, and prefers the hypothesis that Tier Conflation causes fusion:



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2.6 The OCP as a rule trigger

Fusion and antigemination are only two ways of satisfying the OCP. Yip (1988) extends the power of the OCP in such a way that the OCP works as a trigger for rules that repair OCP violations:

> “all rules involving identity of target and trigger with an output in which they are no longer identical and adjacent are OCP-triggered rules.” (Yip 1988, p. 73)

In Yip’s analysis, Tier Conflation exists of two stages. In the first stage, the two morphemes are concatenated. This may raise an OCP violation, which can be repaired by a repair rule if such a rule exists. In the second stage, if no repair rule has cancelled the OCP violation, the remaining adjacent identical elements are automatically fused.

2.7 Long-distance OCP effects

Yip (1988) and McCarthy (1988) work within a theory of underspecification and feature geometry. Under such a regime, elements can be far apart and still be adjacent on a tier with underspecified or privative features. For instance, the two /p/ in /pap/ would either share their [labial] specification, or otherwise violate the OCP. Because in most languages phonological rules normally treat the two /p/ as distinct segments, even if only labiality is targeted, we must conclude that the OCP, understood in this way, is violated by default and is nothing more than a markedness principle. Crisis results.

Steriade (1995) seems to interpret the OCP as a constraint against the repetition of a feature, and Myers (1994) formulates his language-dependent “OCP!” as follows:

> “A feature value [F] should not appear twice inside a specified domain”.

2.8 Multiple strategies in satisfying the OCP

All the outputs proposed by the various theories have the common property that the OCP is not violated. The OCP seems capable of ***blocking*** any rule whose output would violate it, and of ***triggering*** any rule that would prevent or repair its violation. Yip (1988) concludes that the OCP:

> “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.” (Yip 1988, p. 97)

Now we have the situation that a constraint may induce a plethora of effects. As we have seen, this situation clearly poses problems for derivational approaches to phonology. It could only be handled well within a framework that allows the parallel evaluation of all thinkable candidate outputs; therefore, a constraint-based framework. McCarthy’s preference for negative filtering would then be honoured, even for situations that would look like active repair in derivational approaches.

2.9 Violability of the OCP

Though he invented its name, Goldsmith (1976) did not accept the OCP. Odden (1986, 1988, 1995) has presented much evidence that the OCP is not a universal principle.

> “The strongest possible version of the OCP at this point is that there may be a dispreference for adjacent identical tones; languages are free to express this dispreference by constraining lexical representations, by adding rules of tone fusion or tone deletion, or by putting conditions on tone spreading rules. Ultimately, languages retain the option of doing nothing about OCP violations.” (Odden 1995, p. 464)

Our constraint-based framework, therefore, should be one in which constraints may be violable, so that the winner is determined by a language-specific ranking of the constraints; in that case, there would be nothing special at all about the OCP: it would be a violable constraint like all others.

If Prosodic Morphology had not existed, the OCP situation might have induced the paradigm shift that came with Optimality Theory.

3 Functional interpretation of concatenation problems

As is natural in an OT framework, our typology of phonological phenomena will centre around structures and their ***problems***, not about rule types and their applications. The first structure that we will consider, is |ak+ka|.

3.1 Acoustic results

If a morph ending in |ak| is concatenated with a morph that starts with |ka|, the most straightforward result would be an implementation of |akka| with two dorsal closing gestures, timed in the same way as is usual in the language for |apka| and |akpa|. If the language would normally overlap two heterorganic closing gestures (giving [[ap˺_ˑᵏa]] and [[ak˺_ˑᵖa]][2]), the acoustic result of |ak+ka| would be [[ak˺_ˑᵏa]], or [akˑa], with a prolonged closure: a short geminate, acoustically indistinguishable from a single closure with a hold phase. If the language would normally not overlap two heterorganic closing gestures (giving [[ap˺_pʰ_ka]] etc.), /ak+ka/ would still give [[ak˺_ːᵏa]], or [akːa]: a long geminate. This is because two adjacent partially overlapping styloglossus commands would result in a single long dorsal closure (§3.5).

3.2 Perceptual results

To compute the perceptual output of the production grammar, we must run the acoustic result [[ak˺_ːᵏa]] through the perception grammar (Boersma 1998b: ch. 6). Nearly all languages would perceive a *non*-geminate [[ak˺_ᵏa]] as /aka/, which is a shorthand for something with a single perceived dorsal value on the perceptual place tier. This is

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[2] The double brackets indicate a *microscopic transcription*: a transcription with one symbol for every perceptual change (Boersma 1998b: §1.3.3). The sequence [aka], for instance, is transcribed as [[ak˺_ᵏa]]. The three components of the plosive are: transition, silence, burst. The symbols [ˑ] and [ː] mark half-long and long elements, respectively.

because the sequence transition-silence-burst often occurs together in most languages, so that it is advantageous for the listener to perceive them as one. The relevant near-universal ranking of the relevant OCP and no-crossing constraints (Boersma 1998b: ch. 12) is

OCP (place: dor; tr | sil | bu) ***Short-plosive perception***
|
NCC (place: dor; tr | sil | bu)

(19)

The perception tableau is

[[k˺_^{k}]]	OCP (place: dor; transition | silence | burst)	NCC (place: dor; transition | silence | burst)
dor dor \ | k˺_ k	*!	
☞ dor /\\ k˺_ k		*

(20)

Note that the winner violates a weak NCC constraint, since the silence intervenes between the two dorsal cues. If more material intervenes between the two cues, the OCP constraint will be ranked lower, and NCC higher. Thus, for geminate plosives, with their longer silences, the constraints are closer than they are in (19), or may even be reversed. In a language that maintains frequent geminate consonants, we expect that [[ak˺_ː^{k}a]] is perceived with a single dorsal long consonant, just as in (20):

[[k˺_ː^{k}]]	OCP (place: dor; trans | long silence | burst)	NCC (place: dor; trans | long silence | burst)
/kk/	*!	
☞ /kː/		*

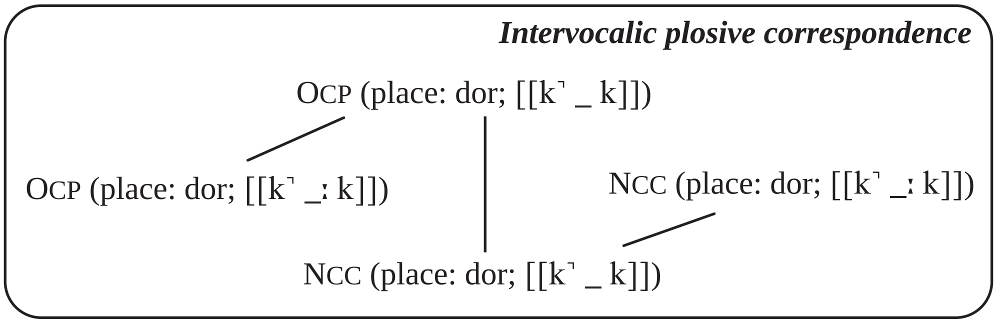
(21)

In a language without geminates, the acoustic input [[ak˺_ː^{k}a]] probably tells something about the heteromorphemic descent of the two dorsal place cues. In such a language, the ranking may well be reversed:

[[k˺_ː^{k}]]	NCC (place: dor; trans | long silence | burst)	OCP (place: dor; trans | long silence | burst)
☞ /kk/		*
/kː/	*!	

(22)

The following graph shows the (near-) universal rankings of the correspondence constraints in the perception grammar:



(23)

This leaves a binary typology, as exemplified in (21) and (22).

3.3 The influence of the OCP on the production grammar

Whether the listener hears *one* dorsal feature value as in (21) or *two* as in (22), determines whether or not the perceptual result of the acoustic form [[ak˺_ːᵏa]] from the underlying form |ak+ka| violates PARSE (place: dorsal). This is the modest influence of the OCP constraint on the production grammar. An asymmetry between heterorganic and homorganic gestures is one of the causes of some “OCP effects”: whereas [ap͡ka] faithfully parses both the labial and the dorsal specifications present in /ap+ka/, the geminate [ak·a] may parse only one of the two dorsal specifications present in /ak+ka/, thus violating PARSE (dorsal): the identity of one of the consonants is lost. The only difference with a rote deletion is the faithful rendering of the timing slot, which may be a sufficient sign of the double specification in languages without tautomorphemic geminates. The following phonetic truth can be stated:

> Adjacent identical gestures may be heard as a single gesture.

It depends on the ranking of PARSE (dorsal) whether the language does anything about the problem. For instance, it could try to produce [[ak˺_ᵏʰk˺_ᵏa]], with two temporally separated complete dorsal gestures, but this would need a quite different syllable timing, effectively inserting a boundary normally used for separating intonational phrases. Let’s say that this would violate FILL (]$_{I\,I}$[), probably a strong constraint in all languages. A somewhat less radical solution would be the insertion of a segment between the two /k/, so that /ak+ka/ would end up as /akəka/ or /akska/ or so[3]. That would violate FILL (segment). The following tableau shows six of the most obvious possible outputs of /ak+ka/:

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[3] In a theory of Feature Geometry with privative features, neither /akəka/ nor /akska/ seem to satisfy PARSE (dorsal), because the two /k/ are still adjacent on the dorsal tier; we should say, in that case, that /akəka/ satisfies PARSE (root), and /akska/ satisfies PARSE (place).

|ak+ka|	FILL ($]_{I\ I}[$)	FILL (noise)	PARSE (k)	PARSE (timing)	*HOLD (tongue)	FILL (ə)
[ak_ka] /ak]$_{I\ I}$[ka/	*					
[akːa] /akːa/ (21)			*		*	
[akːa] /akka/ (22)					*	
[aka] /aka/			*	*		
[akəka] /akəka/						*
[axka] /axka/		*				

(24)

We see that all six candidates are possible winners, depending on the ranking of the seven constraints and the ranking of OCP and NCC for long silences. This proposal makes empirical predictions: for instance, we expect that languages with low *HOLD constraints, i.e. languages with geminates, will not produce [aka], because [akːa] will always be more harmonic. Also, languages with geminates (21), with their PARSE violations, will be more liable to choosing one of the epenthesis or dissimilation candidates. In the following sections, we will examine the conditions that give rise to the various outcomes.

3.4 Separation: ak_ka

Suppose we have the following levels of prosodic organization: discourse, utterance (Σ), intonational phrase (I), phonological phrase (φ), phonological word (W), foot (F), syllable (σ). The higher constituents may be separated by intonation breaks and several sorts of pauses. Each of these phonological boundary markers should appear on the surface, and we can expect that this is more important for higher constituents: PARSE ($]_{\Sigma\ \Sigma}[$) >> PARSE ($]_{I\ I}[$) >> PARSE ($]_{\varphi\ \varphi}[$). For this reason, languages have stronger markers (longer pauses, etc.) for higher constituents. These boundaries should not appear where they do not belong, and we expect that the stronger boundaries are more offending in this respect: FILL ($]_{\Sigma\ \Sigma}[$) >> FILL ($]_{I\ I}[$) >> FILL ($]_{\varphi\ \varphi}[$). Also, a certain boundary will be more offending if it occurs in a lower domain:

$$\text{FILL}\ (]_{I\ I}[\ /\ [\ \_\ ]_W) \gg \text{FILL}\ (]_{I\ I}[\ /\ [\ \_\ ]_\varphi) \gg \text{FILL}\ (]_{I\ I}[\ /\ [\ \_\ ]_I) \qquad (25)$$

If we assume that the lowest domain that uses pauses as boundary markers, is the intonational phrase, then the insertion of a pause in order to faithfully parse both /k/ root nodes in the word-level concatenation of |ak+ka|, involves a violation of the relatively high-ranked FILL ($]_{I\ I}[\ /\ [\ \_\ ]_W$). This explains why languages avoid this situation. We also see why the OCP is often said not to apply across higher prosodic boundaries; across intonational phrases, for instance, [ak_ka] is the usual result.

Nevertheless, there may be situations where pragmatic requirements rerank the constraint system. For instance, if we make up a new compound, which we do not expect the listener to have heard before, we can insert pauses as efficient metalinguistic signals in the utterance itself. On the day that I am writing this[4], I was engaged in the following dialogue with my son (aged 5:0), who had trouble finding the word *wapens* ‘weapons’:

> Jelle: “We played at soldiers”.
> Paul: “With the pirate flag?”
> Jelle: [nɐi ʔɑlʎeimɛt fˈ˦ɛ˩xt deŋə] “No, only-with *fighting things*.”

The new compound /fˈɛxt deŋə/, pronounced with a fully released /t/, was in contrastive focus and had a clearly unaccented /deŋə/ part which signalled that the preceding pause was not a syntactic prosodic boundary[5]. The relevant constraint ranking is

|ak+ka|	FILL (noise)	PARSE (dorsal)	FILL (syllable)	FILL ($]_{I}\,{}_{I}[$)	*HOLD (dorsum)	*GESTURE (dorsum)
☞ ak-ka				*		**
[ak͡ka] /aka/		*!				**
[akːa] /aka/		*!			*	*
aka		*!				*
akəka			*!			**
axka	*!					*

(26)

All the segmental faithfulness constraints have risen and are undominated. We see that in Jelle’s grammar, [akːa] must violate PARSE (dorsal), although Dutch has no geminates; otherwise, [ak͡ka] (with a double dorsal gesture, see §3.5) would always have been a better candidate. This can have two causes. First, Jelle may not have considered the transition a sufficient cue to dorsality, so that he violates PARSE (k) unless he hears two release bursts. Secondly, he may ignore the length in [ak͡ka], so that he ranks OCP as high as for short plosives; this is what I have suggested in (26) by marking two perceptions as /aka/.

Another example was reported by McCarthy (1986): in a Moroccan Arabic language game that reverses the consonants in a word, /ħbib/ ‘friend’ becomes /b-biħ/, with a released first /b/ (at least for one speaker; two others have /bħiħ/, reversing the root sequence before Tier Conflation). McCarthy suggests that the phonetic reflex of an OCP violation is exactly as described here:

> “contrast[s] between singly associated and multiply associated (...) geminates (...) would conceivably have transparent phonetic consequences (like medial release for clusters versus medial closed transition for geminates).” (McCarthy 1986: 255)

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[4] September 22, 1996.

[5] In Dutch, compounding, in contrast with inflection, has the postlexical trait of dependence on the pragmatics, though the choice of the expression of the juncture is lexically and morphologically governed; here, we have the zero allomorph because the first constituent is a verb stem.

If this is indeed the interpretation of the OCP, it can be identified in the production grammar with FILL $(]_I\,{}_I[\ /\ [\ \_\ ]_W)$, and if the occurrence in the languages of the world is restricted to the exceptional types described in this section, this constraint is nearly universally undominated in normal adult language. Much more interesting is a phonological interpretation of the OCP, namely, that a geminate element always acts as a single element in phonological processes; with this interpretation, the OCP is strong, but not unviolable.

3.5 Gemination: akka

With a normal timing of the neural commands for the two dorsal gestures, we get a result that sounds like one prolonged gesture. This may occur in languages without tautomorphemic geminates, as was measured for English by Stetson (1951: 61) and Lehiste, Morton & Tatham (1973). These languages thus have a high *HOLD constraint, and produce the geminate by violating *GESTURE (dorsum) twice:

|ak+ka|	FILL $(]_I\,{}_I[)$	*HOLD (dorsum)	PARSE (dorsal)	FILL (noise)	FILL (σ)	*GESTURE (dorsum)
ak-ka	*!					**
☞ [ak͡ka] /akka/						**
[akːa] /akka/		*!				*
aka			*!			*
akəka					*!	**
axka				*!		*

(27)

This will occur in English compounding: *stock car*, and in the Dutch adult version of the pragmatically conditioned ‘analysing’ pronunciation of an otherwise unclear compound, as in /eːt/ ‘eat’ + /taːfəl/ ‘table’ → [ˈeːt·aːfəɫ] ‘eating table’ and [[vɛxt˺_·ᵈeŋ]] ‘fighting things’, which we can compare with the child’s [[fɛχt˺_ᵗ‿ᵈeŋ]] of §3.4.

3.6 Fusion: ak:a

A language with tautomorphemic geminates will presumably implement a geminate not by two overlapping gestures, but by a single prolonged gesture (low *HOLD constraints). This has been measured for Cellefrouin Gallo-Roman (Rousselot 1891: 86), Hungarian (Hegedüs 1959), and Estonian (Lehiste, Morton & Tatham 1973). The ranking of an organizational articulatory trick like a locational hold probably depends on what the speaker can gain from learning it. This is larger as more geminates occur in the language: for every geminate, a dorsal gesture is saved:

|ak+ka|	Fill ($]_{I\,I}[$)	Fill (noise)	Fill (σ)	Parse (timing)	Parse (dorsal)	*Gesture (dorsum)	*Hold (dorsum)
ak-ka	*!					**	
[ak͡ka] /akːa/					*	**!	
☞ [akːa] /akːa/					*	*	*
aka				*!	*	*	
akəka			*!			**	
axka		*!				*	

(28)

Since in these languages the geminate result violates a Parse constraint, this constraint has to be low-ranked; otherwise, the language will opt for epenthesis.

3.7 Degemination: aka

Parse (timing) is the constraint that requires an underlying C slot on the timing tier to appear in the output. If this is ranked lower than both articulatory constraints and all other faithfulness constraints, the result will be deletion of one of the original /k/:

|ak+ka|	Fill ($]_{I\,I}[$)	Fill (noise)	Fill (σ)	*Hold (dorsum)	*Gesture (dorsum)	Parse (dorsal)	Parse (timing)
ak-ka	*!				**		
[ak͡ka] /akka/					**!		
[akːa] /akka/				*!	*		
☞ aka					*	*	*
akəka			*!		**		
axka		*!			*		

(29)

Note that if the language hears a geminate as two consonants, the output [aka] can only win if Parse (dorsal) is dominated by the gestural constraints; since intervocalic dorsal consonants will usually surface faithfully, the Parse constraint must be conditioned for the geminate environment. Another possibility is that Ocp (place: dorsal; [[ak˺_ː^{k}a]]) is highly ranked after all, so that the two geminate candidates are perceived as /akːa/, which would violate Parse (dorsal), so that this constraint may be highly ranked.

The result of (29) represents the usual action in Dutch lexical phonology. For instance, the past tense of weak verbs is formed with the suffix |-də|. With the stem |mɛld| 'notify', we get /mɛldə/ 'notified'. In the phonology, Dutch appears not to be concerned with preserving the identity of the morpheme; however, the homophony between present- and past-tense forms, which only occurs in the plural forms (/ʋəmɛldə/ ‘we notify’ or ‘we notified’), is circumvented by avoiding the past-tense forms, at least in the spoken language.

On the sentence level, the situation is somewhat different. The following Dutch examples illustrate the relation between the length of a geminate and syntactic constituency[6]:

(a) *We gaan even voor een nieuwe klok kijken* [ɔkːɛi]. “We’ll go shopping for a new clock.” The prepositional phrase can be extraposed: *We gaan even kijken voor een nieuwe klok.*
(b) *Even op de klok kijken* [ɔkˑɛi]. “I’ll look at the clock.” Extraposition is hardly allowed: the verb is strongly subcategorized for looking at gauges, with the preposition *op*. *Klok* is still clearly a noun.
(c) *Ze kan nog niet klokkijken* [ɔkɛi]. “She cannot read the time yet.” *Klok* is incorporated into the verb, as witnessed by the verbal negation *niet* ‘not’, as opposed to the nominal negation *geen* ‘no’ (which is also allowed here).

Cases (a) and (b) have the similarly timed counterparts [pk] (released [p]) and [p͡k] (unreleased [p]); case (c) has no counterpart for heterorganic clusters.

We can now see that a language without geminates does not have the anti-root-node-branching rule (4), interpreted with the help of the OCP, but the constraint ranking *HOLD (C) >> PARSE (C). The question, of course, is whether these analyses are empirically different. If *HOLD (C) and PARSE (C) did not interact with other constraints, the situation would be difficult to decide. However, PARSE (C) interacts with *GESTURE: the constraint ranking set *HOLD (tongue body) >> PARSE (C) >> *GESTURE (tongue body) describes a language like English, which does not allow tautomorphemic geminates, but allows geminates across some morpheme boundaries (stratum-2 affixation; compounding). This only works under McCarthy’s assumption that tautomorphemic geminates are always inseparable, i.e. that they are phonologically single long consonants.

3.8 Epenthesis: akska

Many strands of epenthesis have articulatory causes: satisfaction of synchronization constraints (Dutch [mɛlᵊk], English [tɛnᵗs]). Epenthesis is also possible in order to satisfy the perceptual distinction between two underlying segments or features that would otherwise merge into a cluster that could be analysed in a different way:

Limburgian. Limburgian inserts an /s/ between nouns stem ending in a velar and the diminutive suffix /-kə/ (a full list is in Boersma 1998b: §12.2). Thus, /dɛ́ŋ-s-kə/ ‘thing (dim.)’ inserts an /s/ so that it cannot be confused with /dɛŋ̄kə/ ‘think’. Of course, it is not this actual word pair that is the problem to be solved; rather, Limburgian listeners like to be confident that they can always interpret an [ŋkə] as belonging to a single morph[7]. It

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[6] Of course, these data are highly variable.

[7] The [ə] may be crucial here. In the morphology of the third person singular of the present tense, basically expressed as the suffixation of a /t/ weakly specified for place, the words /zɛ́ŋ-k/ ‘sings’ and /zɛŋ̄k-∅/

may be relevant that the epenthesis originated at a time that the language must still have had geminate consonants.

English. Plurals and past tense: /hʌg-z/ ‘hugs’ but /kɪs-ɪz/ ‘kisses’: vowel insertion between two sibilants; /lɪv-d/ ‘lived’ and /kæn-d/ ‘canned’ but /wɔnt-ɪd/ ‘wanted’ and /niːd-ɪd/ ‘needed’: vowel insertion between two coronal stops. McCarthy’s (1986) generalization of the idea that both /tt/ and /dt/ appear to constitute OCP violations, is that the sequence /dt/ would consist of two identical elements after voicing assimilation. Yip’s (1988) rule of “Coronal Epenthesis” reads thus:

Domain: Coda
Tier: (i) Strident
(ii) Continuant
Trigger:
Change: Insert

Thus, this rule repairs sequences like /ʃz/ and /td/ in coda, by epenthesizing a vowel that puts the first consonant in an onset position; the sequences must have a specification on the stridency tier (presumably, all coronal obstruents), agree in stridency (to rule out /θs/), and agree in continuancy (to rule out /ðd/). The trigger of the rule is not specified, because it is a universal trigger: the OCP. There are several problems with Yip’s approach.

I would like to express the fact that */ʃz/ and */td/ are morpheme-structure constraints as well: in English morphology, they do not occur until the stratum of compounding[8]. However, Yip has to restrict the domain of the rule to the coda because if the domain were a phonological word, the consonants would still be adjacent on the stridency tier; epenthesizing a vowel, with no specification on the stridency tier, would not make the OCP satisfied on that tier.

Fricatives are often economically divided into *non-strident* (/ɸ/, /θ/, /x/) and *strident* (/f/, /s/, /ʃ/, /χ/). In contrast with what the label suggests, this division is based on distributional grounds: the strident fricatives are louder (make more noise) than their non-strident counterparts on the same articulator, and are, therefore, on the average more suitable for human communication in a world with background noise and distances; the non-strident fricatives, on the other hand, often alternate, or are historically related to, plosives at the same place of articulation; as so happens, plosives tend to occur at locations where perfect closures are easy to make (bilabial, corono-postdental, dorso-velar), and fricatives prefer locations with small holes (labio-dental, corono-dental) or unstable structures (dorso-uvular). From the perceptual standpoint, however, we could divide the stridency scale into three levels:

1. **Mellow**: low-frequency noise (“grave”): [ɸ], [x].

‘sinks’ can only be distinguished by their different tones, which was not enough for */dɛ́ŋ-kə/ versus /dɛŋ̄k-ə/. Alternatively, we could argue that diminutive formation is at a more superficial level of derivation than verb inflexion, causing different degrees of importance to be attached to the prevention of the two /ŋ+k/ clashes: PARSE (dorsal / _ +*dim*) >> FILL (s) >> PARSE (dorsal / _ +*3sg*). We see yet another possibility when we realize that [dɛ́ŋs.kə] can be syllabified perfectly, whereas *[zɛ́ŋsk] is problematic.

[8] Morphologically, compounding takes place after inflection. The morphological bracketing [[apple] [[pie][s]]] does not necessarily coincide with the semantic bracketing [[[apple][pie]] s].

2. **Strident**: high-frequency noise ([f], [θ]) or amplitude modulation ([χ]).
3. **Sibilant**: strong noise: [s], [ʃ].

The problem with */fɪʃs/ is the unpronounceability of a boundary between /ʃ/ and /s/: the same articulator is involved and has to move from one shape and position to another; if the gestures overlap, the result is a long sibilant without much temporal structure, so that it will be heard as one; thus, PARSE (sibilant) is violated, if that constraint is considered as an evaluation of the relation between perceptual features in the input and the output. By contrast, the two sibilants in /fɪʃɪz/ 'fishes' and /hɔːsɪz/ 'horses' are clearly separated in time, and PARSE (sibilant) is not violated.

Thus, though the same articulator is involved in both segments, the problem of their concatenation is of a perceptual nature. We can find some more evidence for this when we look at other weakly contrasting fricatives in English.

First, there is /θs/, which seems not to pose many problems in /klɔθ+s/ 'cloths'; though both segments use the same articulator, the temporal separation between the [θ] and [s] parts is clear, because the mode of noise generation changes from local (between the teeth) to dipole (smashing a jet of air against the teeth), resulting in a large change of intensity (somewhat smaller for the voiced versions). We find an optional fusion in the morphologically hardly analysable word /klou(ð)z/ 'clothes', and an occasional dissimilation in /sikst/ 'sixth'.

Secondly, there is /fθ/. Though produced on different articulators, these dental fricatives are perceptually very similar. It is no coincidence that we find /fɪft/ 'fifth' and /twɛlft/ 'twelfth': in this dissimilation, the conflict is between losing the root node and losing the [fricative] specification, which must be underlying because the morpheme ends up as [θ] on other numerals. This is a clear case of perceptually motivated dissimilation; articulator tiers have nothing to do with it.

Another problem in Yip's analysis, is that, in order to account for */td/, she has to assume that /t/ and /d/ have non-redundant [–strident] specifications. A generalization to "coronal stop" is impossible, because that would include /n/, which is inappropriate in the view of /kæn+d/ 'canned', where we find no epenthesis. Reality is simpler again. If there were no epenthesis, the past tenses of /wɔnt/ 'want' and /niːd/ 'need' would be equal to the present-tense forms (assuming the same voicing assimilation as with other final consonants, and degemination); so we would have a lot of morphologically related homonyms in a language that otherwise expects tense marking: a functionally undesirable situation, which a language may choose to prevent. This situation is much less severe for /n/-final verbs: /fain+d/ 'fined' may be homophonous to /faind/ 'find', but in practical situations its /-d/ has a much larger chance of being recognized as a tense marker than the same suffix in */niːd/ 'needed' would have. This functional explanation is straightforward and not very controversial, and in a functional view of phonology it should be directly formalizable. In */niːd/ 'needed', we would have violations of all PARSE constraints that can be associated with /d/, most notably segmental identity, which we could write as PARSE (root); in /fain+d/, which makes the final cluster undistinguishable from a monomorphemic one, we have a violations of PARSE (coronal) if the relevant OCP is ranked high, but PARSE (timing) and PARSE (nasal & coronal) are satisfied. The intuitive idea that more is lost in /d+d/ → /d/ than in /n+d/ → /nd/, can be formulated as the near-universal ranking PARSE (root) >> PARSE (coronal). This ranking becomes crucial as soon as an interacting constraint is allowed to intervene. In our case, this intervening constraint is a constraint against the insertion of a syllable or a vowel:

<table>
<tr><th>|wɔnt+d|
|kæn+d|</th><th>PARSE
(root)</th><th>FILL
(ɪ)</th><th>PARSE
(coronal)</th></tr>
<tr><td>wɔnt</td><td>*!</td><td></td><td>*</td></tr>
<tr><td>☞ wɔntɪd</td><td></td><td>*</td><td></td></tr>
<tr><td>☞ kænd</td><td></td><td></td><td>*</td></tr>
<tr><td>kænɪd</td><td></td><td>*!</td><td></td></tr>
</table>

(30)

This analysis seems more straightforward than Yip's statement that /n/ does not cause an OCP violation because it is not specified for stridency (as opposed to the [–strident] of the plosives).

We can now predict a typology depending on the ranking of the FILL constraint:

(1) FILL is ranked high: no epenthesis; fusion may result. The situation in Dutch past-tense formation (see below).
(2) FILL is ranked in between: epenthesis between homorganic plosives. The situation in English and German (see below) past-tense formation.
(3) FILL is ranked low: epenthesis between all homorganic consonants. The situation in Limburgian diminutive formation (see above).

Hungarian. In the formation of the Hungarian preterite, a mid vowel is inserted after a stem that ends in /t/: /keːr+tɛm/ 'I asked' versus /ʃyt+øtːɛm/ 'I baked'. With a stem in /-d/, the epenthesis occurs only in some verbs.

German. The German past tense is formed like /main+tə/ 'meant' and /max+tə/ 'made', but coronal plosives insert a schwa: /mɛld+ətə/ 'reported'. The same ranking as in English.

Typologically, we see that epenthesis is more probable if the two segments are more alike. Thus, epenthesis into English /d+d/ is not joined by epenthesis into /n+d/. In Limburgian, on the other hand, the existence of epenthesis into /ŋ+k/ presupposes epenthesis into /k+k/. This dependence of the ranking of the OCP on perceptual similarity was predicted in Boersma (1998b: §12.3).

4 Blocking of rules

Instead of as a rule *trigger*, the interaction of OCP with PARSE can also work as a rule *blocker*. With output-oriented constraints, the distinction between triggering and blocking often becomes meaningless.

4.1 Elision blocked

Strongly related to the phenomenon of epenthesis (in fact, often indistinguishable from it), is the idea that the force of clash prevention can cause exceptions to an otherwise general rule of elision:

Malayalam. Vowels can be elided between consonants, in casual speech, but not if that would produce a geminate (Mohanan 1986: 168):

> waːkate ‘a type of tree’s’ → waːkte
> kaʈaʈe ‘shop’s’ → kaʈaʈe

It is crucial here that geminates are very common in Malayalam, so that there would be a large parsing problem if spurious geminates would surface. For instance, if |kaʈaʈe| is pronounced as [kaʈʈe], it will be perceived as /kaʈːe/, violating PARSE (root / C). The grammar is something like PARSE (root / C) >> *SYLL >> PARSE (root / V).

Bärndütsch. The article /di/ ‘the’ surfaces as [d], except before /d/:

> d-gægəd ‘the neighbourhood’
> di-dœrfər ‘the villages’

Tiberian Hebrew. (McCarthy 1986): schwa deletion is blocked between identical consonants:

> zaːχəruː → zaːχruː ‘they recalled’
> saːβəβuː ‘they surrounded’ (from the root /sb/, after Tier Conflation)

English. /n/ engages in degemination: the fricative /s/ can be followed by syllabic /n/, which may come from the factitive morpheme: /lɪsn̩/ ‘listen’, /fɑːsn̩/ ‘fasten’. After coronal plosives, the morpheme vacillates between a syllabic nasal and /ən/: /flætən/ or /flætn̩/ ‘flatten’, /mædən/ or /mædn̩/ ‘madden’. After /n/, we find no syllabic nasals: /lɪnɪn/ ‘linen’. Again, syncope is more likely if the perceptual identity of the segments is preserved better.

4.2 Assimilation blocked

Another implementation of clash prevention at morpheme boundaries, is the refusal to do the usual assimilation:

Limburgian. Postlexical place assimilation of nasals, though uncommon, is thinkable, but in diminutive formation, it is out of the question: the diminutive of /mɑn̄/ ‘man’ is /mǽnkə/, and that of /bɛīn/ ‘leg’ is /bɛ́inkə/. Apparently, PARSE (place: dorsal / kə) is ranked quite high, as we already saw with /s/ insertion between it and a base ending in a dorsal consonant (Boersma 1998b: §12.2): the diminutive suffix must stand out from the base.

Malayalam. According to Mohanan (1995), we find /an-pə/ ‘kindness’, which constitutes an exception to a postlexical rule that assimilates the place of nasals to the following plosive.

According to Mohanan & Mohanan (1984), nasals assimilate to the following plosives, but not to nasals, which would give geminates:

bᵊaːlan+poːdʒᵊi → bᵊaːlamboːdʒᵊi ‘the boy went’
n̪an-ma ‘goodness’

This situation can be described with the grammar PARSE (nasal) >> *GESTURE >> PARSE (place). Note that */n̪amːa/ would violate PARSE (nasal).

4.3 Sound change blocked

The case of English /fɪft/ and /sɪkst/, which we saw in §3.8, may well continue an exception to the Early Germanic spirantization of voiceless plosives: while an Indo-European /t/ became /θ/ in Germanic (compare Latin /treːs/ ‘three’ with English /θriː/), this change did not occur after a (old or new) fricative (Latin /staːre/ ‘stand’ vs. English /stænd/; Latin /nokte/ ‘night’ vs. Dutch /nɑxt/). If OCP (noise) is ranked high enough (for no intervening material), the sequences [sθ] and [xθ] would be perceived with a single value on the noise tier, which may lead to perceiving a single value on the place tier, violating PARSE (coronal).

5 Articulatory dissimilation

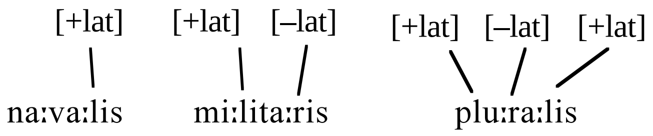
All the cases of §3 and §4 avoided a perceptual problem. We shall now see two cases of dissimilation at a distance, commonly ascribed to the OCP.

Dissimilation of [lateral] in Latin. The Latin suffix |-aːlis|, which produces adjectives, turns up as /-aːris/ if the base contains an /l/, except if that /l/ is followed by an /r/ (Passy 1891: 201):

naːv+aːlis	‘naval’
miːlit+aːris	‘military’
pluːr+aːlis	‘plural’

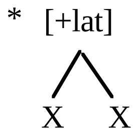
To account for this, we could say that /l/ and /r/ are ***lateral-bearing*** segments, and state the allomorphy rule as follows, without the OCP: “within a single word, there cannot be two adjacent lateral segments on the partial segment sequence that consists of all lateral-bearing segments”. Thus, in our three cases these partial sequences would be /l/, /lr/, and /lrl/, respectively, and */miːlitaːlis/ would be ruled out because its partial lateral-bearing sequence would be the offensive */ll/.

Though descriptively adequate, the above formulation of the rule does not explain the phenomenon in terms of any fundamental principle. The Obligatory Contour Principle may come to the rescue, since this principle has repeatedly been used for the “explanation” of all sorts of dissimilatory phenomena. First, we re-represent the three words in an autosegmental notation, as follows:



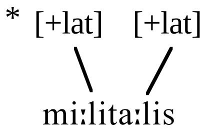
(31)

With the OCP, the rule would now be restated thus: “within a single word, [+lateral] cannot be multiply linked” (i.e., linked to more than one segment), or: “[+lateral] cannot branch”:



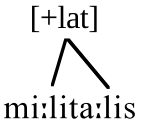
(32)

Now, the OCP helps to get the right result, because



(33)

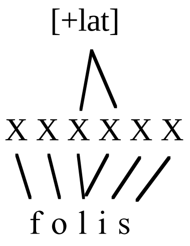
is an illicit representation ruled out by the OCP itself, and



(34)

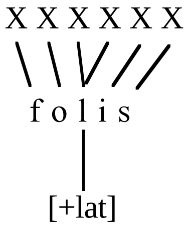
is ruled out by the Latin “don’t branch” rule (32). Crucial in this example is that the feature value [–lateral] is linked to any non-lateral lateral-bearing segment (here the /r/), otherwise the two *l*’s in *pluralis* would be adjacent on the [lateral]-tier and thus would have to be linked, because of the OCP, to the same [+lateral] specification. In other words, [–lateral] is phonologically active here.

Still, however, nothing has been explained: the OCP only enabled us to state the rule in two words. Fortunately, the “don’t branch” rule is even descriptively wrong: Latin has geminate laterals. The word /folːis/ ‘leaf’, for instance, must be represented, according to the OCP, as



(35)

The solution, in this case, is the correct linking of [lat] to the root node:

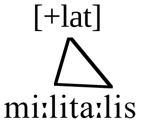


(36)

So there is no branching [+lat]. This procedure allows us to differentiate between repetition and lenghtening of a gesture: these processes are phonetically very different, and I cannot imagine that this difference would not be reflected in phonological processes. Nevertheless, in her analysis of Seri (Marlett & Stemberger 1983), Yip (1988) attributes both the rule /ʔaʔ/ → /ʔaː/ and the non-occurrence of the long glottal stop */ʔː/ to the same prohibition on branching glottal stops.

Going back to the *function* of the phenomenon may yield us genuine explanations. Certainly, we cannot take refuge to the dissimilarity-by-hypercorrection hypothesis by Ohala (1993), because we are talking about transparent morphological alternations here.

The problem in */miːlitaːlis/ seems to be the repetition of the lateral gesture (or the lateral feature). But the fact that a /r/ would break the ban, suggests that the really offensive implementation is



(37)

Here, the lateral gesture would continue throughout the /litaːl/ sequence. This is a possible articulation, but the perceptual result, a violation of FILL (lateral & vowel), appears so offensive that /miːlitaːris/, violating /l/ → [+lateral], is a better candidate. In /pluːraːlis/, we find the strong specification /r/ → [trill]; the trill is *not* compatible with the labial gesture and thereby prevents the coalescence of the two lateral gestures.

There is a strange coincidence here: the allomorphy /-aːlis/ → /-aːris/ proves that /l/ and /r/ form a natural class (they must have something in common perceptually). On the other hand, /r/ breaks up laterality, so it must be articulatorily incompatible with /l/, and perhaps articulatorily very different.

An analysis with a privative [lateral] feature was proposed by Kenstowicz (1993). In /floːr+aːlis/, the delinking of [lat] is blocked because /floːraːris/ would violate the OCP on the [rhotic] tier. Steriade (1995) rephrases this in OT terms as

PARSE (rhotic) >> OCP (rhotic) >> OCP (lateral) >> PARSE (lateral) (38)

This elegant solution does not work. Besides the fact that (38) may not be general (Latin allows /kelː-ula/ 'small room' and /reːgaːl-iolus/ 'wren'), it would also predict that any /r/ in the base would cause selection of the /l/ allomorph. Thus, we would expect */reːgul-aːlis/ instead of /reːgul-aːris/ 'regular', because the latter would violate OCP (rhotic) on the privative [rhotic] tier. Unfortunately, in this example we may have transparently /reːg-ula/ as a base; monomorphemic /r-l/ sequences cannot be found, because of a restriction against two liquids in Indo-European roots[9]. We cannot ask the speakers of the language that seems to continue Latin phonology as its stratum I, as they

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[9] /flor-/ and /plur-/ derive historically from intervocalic /s/.

seem to have reduced the maximum distance of this rule to the preceding syllable: witness *velar* and *alveolar*, but *palatal* and *laminal* (beside *laminar flow*); if Dutch *prullaria* 'knick-knacks' from *prul* 'piece of trash' + Lat. *aːlis* (neuter plural) were a Latin word, we would almost have disproved Kenstowicz's proposal.

Dissimilation of [voiced] in Japanese. In Japanese, there cannot be more than one voiced obstruent in the expression of one originally Japanese word stem. Thus, *gado gado* is not a Japanese meal. This constraint actively prevents the usual voicing of an obstruent in the morphological operation of *compounding*. Thus, while /ori/ 'fold' + /kami/ 'paper' gives /origami/, the same process is prohibited in /onna/ 'woman' + /kotoba/ 'word', which gives /onnakotoba/ 'women's speech' because */gotoba/ is ill-formed.

Though Itô & Mester (1986) invoke the OCP, the phenomenon resembles the Latin data given above. The difference is that the /t/ in /kotoba/ does not seem to license two separate [+voice] features: we cannot say that the two voiced obstruents are adjacent, if we define adjacency as follows (also Myers 1994 and Archangeli & Pulleyblank 1994): "two features are adjacent on a tier if there are no intervening feature-bearing units". Now, /t/ is obviously a voice-bearing unit, so /g/ and /b/ would not be adjacent in */gotoba/. Gesturally speaking: whatever articulatory trick causes the two obstruents to be voiced, that trick is not used on /t/, so that we have two separate gestures. Apparently, the problem here is a genuine problem of repetition, of articulatory or perceptual nature (for once, we do not know yet).

A simple answer to our problems is a *REPEAT(*f*) constraint. Whether *f* is an articulatory gesture or a perceptual feature, remains to be seen. The *REPEAT constraint works on a language-particular basis, and on selected domains: in Latin, we have *REPEAT (lateral) on the "base + *aːlis*" domain; in Japanese, we have *REPEAT (voice) on the domain of the Yamato morpheme. The question of the different behaviour of /r/ in Latin and [–voice] in Japanese, must be put aside for the moment.

6 Conclusion

Most alleged OCP effects can be reduced to interactions of more fundamental PARSE and *GESTURE constraints, under the influence of two families of correspondence constraints in the perception grammar, which I called OCP and NCC. The near universality of some OCP effects is due to the high ranking of a constraint against inserting pauses. Typological predictions can be made on the basis of the dependence of the perceptual OCP and NCC constraints on the perceptual similarity of the two segments involved, on the distance between them, and on the probability that the two segments will be heard as one when adjacent, which again depends on the frequency of the occurrence of the sequence in the language.

Long-distance "OCP effects" must be ascribed to the workings of an anti-repetition constraint. *REPEAT militates against long gestures across intervening segments. It can be reset by an interrupting conflicting gesture, required by a perceptual specification.

The OCP, to sum up, is not an autosegmental primitive, and does not have to be described as a separate innate phonological device.

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