

THE MAXIMAL ONSET PRINCIPLE AND GOVERNING RELATIONS BETWEEN SEGMENTS

Haruko Miyakoda
Tokyo University of Agriculture and Technology

1 Introduction

It is a well-known fact that segments are grouped into constituents based on hierarchy. It is generally assumed that the Maximal Onset Principle is at work. Therefore, when dealing with word internal consonant clusters that may be syllabified in more than one way, the clusters will have maximal length in the onset rather than in the rhyme position. This principle is consistent with the general constraint that word initial consonant clusters always form onsets.

In this paper, several 'exceptional' examples that seem to contradict this principle will be documented. Then, we will provide an alternate analysis based on the elemental approach.

2 The Maximal Onset Principle

Although it was generally assumed that segments are grouped into constituents based on hierarchy, it was after the works such as Kahn (1980), that the tendency for words to be syllabified according to the maximal length of initial consonant clusters came to be formalized as a principle. This principle, the Maximal Onset Principle, states that within a given consonant cluster that may be syllabified in more than one way, the consonants will be assigned maximally to the onset of the following syllable rather than to the preceding rhyme position (e.g. *prosper*, not *prosper*). A study of the world's languages shows that this tendency towards maximal initial clusters seems to hold in general in many languages. Yet, there are some examples, both word internally and word initially, that seem to contradict this maximal approach.

3 Word internal consonant clusters

In this section, let us first examine the case of word internal consonant clusters. We will first take up the lengthening process seen in Italian, which causes a problem for the maximal approach.

3.1 Italian Open Syllable Lengthening

Within the maximal onset approach, the word internal consonant clusters will be grouped 'maximally', that is, the consonants will be assigned maximally to the onset position of the second syllable, provided the consonant clusters in question are observed in word initial onset positions.

(1)	a	[fa to]	'fate'	[me ro]	'pure'	[pe lo]	'hair'
	b	[fatto]	(*[fa tto])	'fact'	[parko]	(*[pa rko])	'park'
	c	[ka pra]	'goat'	[sa kro]	'sacred'	[re tro]	'behind'
	d	[pasta]	'pasta'	[fyasko]	'flask'	[krespo]	'pancake'

Kaye et al (1990: 204)

In Italian, stressed open syllables are usually lengthened as we see in 1a, but when stress occurs on a closed syllable, lengthening does not take place (cf 1b). In the case of a word containing an internal branching onset, the preceding stressed syllable is open, hence, the vowel lengthens as in 1c. There are, however, consonant clusters

that do not adhere to this pattern (cf 1d)

If the internal consonant clusters /st/, /sk/, /sp/ were indeed onsets, the preceding vowel would be lengthened as in 1c. However, the initial syllable of each word in 1d, although satisfying all the conditions, does not lengthen. This would lead us to assume that the consonant clusters in 1d do not constitute branching onsets.

Within the maximal onset approach, however, since all the consonant clusters can be found at word initial 'onset' positions (*studente* 'student', *spesso* 'thick', *scuro* 'darkness'), the examples in 1d would all be considered to form branching onsets, and there would not be any way to distinguish them from those in 1c.

3.2 Indo-Aryan gemination

Additional evidence against the maximal approach can be seen from Indo-Aryan examples. According to Hock (1991:129), consonants were geminated in the course of the language's history in certain contexts:

- (2) *putra* > *putra* 'son'
adya > *addya* 'today'

In view of the maximal onset approach, gemination can be described as occurring on the initial segment of the branching onset. But here, let us consider the examples in 3:

- (3) *ghanaspati* > *ghanasppati* 'tree'
asmīn > *asmmīn* 'in that one'

Unlike the examples in 2, gemination occurs *not* on what seems to be the initial member of the onset but rather on the second element. Here, again as in the case in Italian, what is assumed to be the initial member of the internal onset is ignored. Within the maximal approach, we cannot capture the different behavior between the two types of clusters in 2 and 3.

Up to this point, we have been dealing with word internal consonant clusters. It might, therefore, be argued that since there is more than one possibility to syllabify the clusters, the 'exceptional' cases do not necessarily violate the general principle of maximality. So, in the next section, we will take up consonant clusters in word initial position, which would provide better proof that, contrary to the claim made within the maximal approach, not all segments can be constituted into onsets just because of their positions.

4 Word initial consonant clusters

The examples to be examined here, the word initial consonant clusters, unlike the word internal ones, can only be syllabified in one way within the maximal approach. Consequently, there would be less ambiguity in dealing with these types of clusters, as they would be assumed to always form 'onsets'. Let us start by examining evidence from Italian:

4.1 Italian definite articles

Italian has two forms for the masculine definite articles. The form *il* occurs before words that begin with a

consonant, otherwise, *lo* occurs. Examples taken from Davis (1992: 72-73) are shown in 4

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|-------|-------------------|-----------------|--------------------|---------------|
| (4) a | <i>il burro</i> | 'the butter' | <i>il capitale</i> | 'the capital' |
| | <i>il gorgo</i> | 'the whirlpool' | <i>il sale</i> | 'the salt' |
| b | <i>lo iodio</i> | 'the iodine' | <i>l'affare</i> | 'the affair' |
| | <i>l'est</i> | 'the east' | <i>l'osso</i> | 'the bone' |
| c | <i>il braccio</i> | 'the arm' | <i>il cratere</i> | 'the crater' |
| | <i>il globo</i> | 'the globe' | <i>il premio</i> | 'the prize' |

In 4a, 4b, the examples show that the forms *il* and *lo* are complementary: the *il* form appears when the following word begins with a consonant, the *lo* precedes a vowel initial word. In the case of consonant clusters in 4c, the definite article behaves in the same way for the words beginning with a single consonant: the *il* form appears. There are, however, certain consonant clusters that are not consistent with the pattern seen in the examples in 4c.

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|-------|----------------------|---|--------------------|-----------------|
| (5) a | <i>lo ftalacene</i> | 'the phthalazine' | <i>lo sbaglio</i> | 'the mistake' |
| | <i>lo scampo</i> | 'the rescue' | <i>lo sdentato</i> | 'the toothless' |
| | <i>lo spirito</i> | 'the spirit' | <i>lo studente</i> | 'the student' |
| b | <i>lo mnemometro</i> | 'the (device for measuring mnemonic processes)' | | |
| | <i>lo smalto</i> | 'the pavement' | <i>lo snob</i> | 'the snob' |

The examples in 5, taken from Davis (1990, 1992), are different from those in 4c in that the masculine definite article *lo*, which occurs before vowel initial words, appears as though the initial consonant clusters of the following words are transparent. In order to account for the different patterns in these two types of clusters, the maximal approach would not do, since there is no way to make the distinction between these two different patterns.

4.2 Raddoppiamento sintattico

Another example, also from Italian, in which word initial clusters behave in an exceptional way is observed in Raddoppiamento sintattico.

Raddoppiamento sintattico is a process where gemination of a word initial consonant takes place following a word ending with a stressed vowel.

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|-----|---|---------------------------------|--------------------|---------------------------|
| (6) | a | <i>meta</i> [f] <i>arfalla</i> | 'half a butterfly' | |
| | b | <i>meta</i> [g] <i>rillo</i> | 'half a cricket' | |
| | c | <i>meta</i> [s] <i>corpione</i> | 'half a scorpion' | (Nespor & Vogel 1986: 38) |

The data in 6a, 6b make explicit the fact that word initial consonants geminate as long as the preceding vowel is stressed. It does not matter whether the consonant belongs to a branching or non-branching onset. But in 6c, the initial /s/ does not geminate (*[s] *corpione*) although it apparently appears in the same environment. In this case, due to the peculiar behavior of the consonant /s/ itself? But as the example in 7 shows, when /s/ appears alone in word initial position, Raddoppiamento sintattico is triggered.

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|-----|--|---------------------------|
| (7) | <i>Un levriero costerà</i> [s] <i>uppergiu mezzo milione</i> | |
| | 'A greyhound will cost about half a million' | (Nespor & Vogel 1986: 39) |

This leads us to conclude that it is not the characteristic of the /s/ consonant that blocks gemination in 6c. Rather, only in the case where a consonant follows the initial /s/ is Raddoppiamento sintattico not triggered. We thus assume that the status of the initial consonant cluster in 6c is different from the other 'general' cluster types found in 6b. Here again, the maximal approach would not be able to account for this distinction.

4.3 Simplification in reduplication

Our third example concerns onset simplification in the process of reduplication. In Steriade (1988), the process of template matching is employed to capture the onset simplification in reduplication.

It is a well-known fact that there is a markedness hierarchy of syllabic structures. For example, onsetless syllables are more marked than syllables with onsets, closed syllables are more marked than open ones, etc. The role of prosodic templates is to eliminate the marked options from the syllabic structures. The basic principle in template matching is the following:

- (8) Eliminate from the base a unit disallowed by the template

Following the principle in 8, Steriade postulates a matching procedure, or instruction on the application of this principle, for complex onsets. The format for the statement of matching procedures contains three elements: a parameter of prosodic weight or syllabic markedness, a setting of that parameter, and the means by which an input string can be made to satisfy that setting. In the case of complex onsets, the matching procedure can be summarized as in 9.

- (9) Parameter: complex onset
 Setting: unmarked (=complex onsets disallowed)
 Matching procedure: [principle 8 applies to non-initial onset consonants]
 (Steriade 1988: 81)

Let us now consider how this matching procedure handles the examples of onset simplification in 10.

- (10) Ancient Greek
ke-klhka 'I have reclined'
pe-pleuka 'I have sailed'
 (Brockhaus 1995: 216)

Since complex onsets are considered to be the marked case, the basic idea here is to eliminate one of the two segments belonging to the branching onset of the base form. The remaining element would be reduplicated. According to the matching procedure in 9, onset simplification can be described as a process eliminating the non-initial element of the onset. This holds true for all the examples of simplification given in 10: it is always the second element of the branching onset that undergoes deletion. The matching procedure can also adequately deal with other instances concerning the reduction of a branching onset. In child language, for example, it is the non-initial element of the onset that is reduced (*clothes* > /koʒ/, *blanket* > /baka/ (Fee 1995: 46)). We may thus assume that Steriade's claim is effective in capturing all types of onset simplification. Yet, consider the following examples:

- (11) a Sanskrit
tan - stan 'thunder'
kan - i - skand 'leap'

b Greek

ka - skandiks 'wild chervil'

ko - skulmat - ia 'leather cuttings' (Steriade 1988:135)

The examples in 11 are taken from Sanskrit and Greek reduplication. In these words, it is the non-initial element of the onset in the base form that is copied, not the initial one. Applying the matching procedure to these examples will result in unsatisfactory forms (**san - stan*, **san - i - skand*, **sa - skandiks*, **so - skulmat - ia*). Thus, it is presumed that the /st/ /sk/ clusters do not constitute the branching onset. Rather, the /t/, /k/ are the only members of the onset and are eligible to undergo reduplication.

Although Steriade's account based on template matching is sufficient to handle onset simplification, it seems to be an ad hoc description. As criticized in Brockhaus (1995:216), there are few, if any, phonological events which must refer to the initial / non-initial consonant distinction.

In the analysis below, we will show that the notion of head projection would be more effective in dealing with the simplification process in reduplication. We can do away with the ad hoc description and capture it by applying the general principles and parameters that are at work within the element approach. This would allow a more integrated formalization of the phenomenon.

Before going into detail, let us briefly summarize some general notions of the elemental approach that will be crucial to our analysis.

5 Licensing Principle

One salient characteristic of the element approach has been the rejection of the rule component. Instead of formalizing phonological processes with the notion of rules and rule ordering, phonological events are conceived of as occurring freely in direct response to universal principles and parameters. The main focus is on the relation of the phonological strings.

Phonological positions are subject to the Licensing principle in 12.

(12) Licensing Principle

All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain. (Kaye 1990:306)

Government is considered to be one form of licensing. Governing relations are established at three levels of structure: within syllabic constituents, between constituents, and between the nuclear heads of constituents. For a governing relation to hold, the notions of adjacency and directionality are crucial.

For two segments to establish a governing relation, they must be 'adjacent' at some structure level. This means that the two segments are actually adjacent, being positioned side by side at the segmental level; otherwise, they are 'adjacent' at some projection level even if other segments, in fact, intervene.

The notion of directionality is closely related to the grouping of segments into constituents. If the dominating position governs its dominee from left-to-right, then they are in (intra)constituent relations. If the governing direction is from right-to-left, then the two segments are in interconstituent relations.

Together with the notions given above, there is another condition that plays an important role in the element approach the condition concerning complexity, which we will turn to next

6 The Complexity Condition

In this section, we will focus on the condition concerning the complexity of the internal structure of segments This condition will be crucial in determining the relationships between segments

(13) Complexity Condition

Let α and β be segments occupying the positions A and B respectively Then, if A governs B, β must be no more complex than α (Harris 1990:274)

This condition on complexity claims that if a segment A governs B, the internal structure of A would have to be more complex than that of B The complexity value of a segment is determined by the number of elements in the internal composition

(14)	s	t
	x	x
	R	R
	h	h
	H	?
		H

The internal structure for the consonant cluster /st/ is given in 14 The /s/ does not have the potential to govern the following /t/ because the number of elements is less than that of the /t/ Consequently, they are not in constituent relations but in interconstituent relation the more complex segment governs the preceding, less complex segment from right-to-left

The difference in the internal structure of the words has led to the different behavioral patterns for the two types of consonant clusters in 1c and 1d(cf ka pra vs pas ta) The consonant clusters are in different relations in the case of the /pr/ cluster, the /p/ has more internal structure, hence, can dominate the following /r/ from left-to-right(p[U, ?, h, H] vs r[R]), whereas, in the case of the /st/ 'cluster', the /s/ cannot dominate the following /t/ because the /t/ is more complex (cf 14) Therefore, the /s/ is syllabified into the coda position of the first syllable and the /t/ becomes the non-branching onset of the following syllable

Just as in the Italian example given above, the Indo-Aryan gemination gave rise to two types of consonant clusters (cf 3.2) The reason why some cluster initial elements geminate while others do not is due to the difference of the internal structure of the consonants The structural differences between the examples in 2 and 3 can be made explicit (cf pu tra t[R, ?, h, H] r[R] vs gramas pato s[R, h, H], p[U, R, h, H])

In the following section, let us examine word initial consonant clusters We begin our discussion with the

onset simplification process given above (cf 4 3)

7 Word initial clusters

Recall that we mentioned above that Steriade's approach to onset simplification seems to be an ad hoc description. As summarized in Brockhaus (1995: 216), a more general analysis can be achieved by assuming that mapping occurs only on the head projections of the stem melody.

Within the present framework, this can be rephrased as follows: only governors of a prosodic constituent can reduplicate, never governees. By adopting this principle on head projection, onset simplification in reduplication can be dealt with in a more theory-integrated way than the template matching procedure. Let us review the examples given above, repeated here as 15.

(15) a Ancient Greek

ke-khika 'I have reclined'

pe-pleuka 'I have sailed'

(Brockhaus 1995: 216)

b Sanskrit

tan - stan 'thunder'

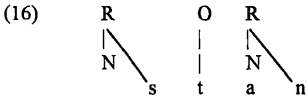
kan - 1 - skand 'leap'

c Greek

ka - skandiks 'wild chervil'

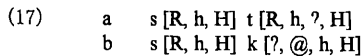
ko - skulmat - 1a 'leather cuttings' (Steriade 1988: 135)

Since the consonant clusters in 15a and those in 15b, 15c differ in the way that they behave, it is assumed that different governing relations hold for the clusters for the two types. The initial consonant clusters found in the examples in 15a occupy branching onset positions. In the case of the clusters in 15b, 15c, however, the following structure is assumed:



If the initial /s/ constituted a branching onset with the following /t/, it would have to be the /s/ and not the /t/ that is reduplicated. Since the head of an onset is the left branching segment, the head projection principle presented above would reduplicate the /s/, deriving an ill-formed **san-stan*. But since the /s/ is not reduplicated, it cannot be the head in this case. Rather, the following /t/ alone occupies the position of the onset, hence is reduplicated.

We can turn to another argument that goes against grouping /st/ together as an onset. This involves the notion of the complexity condition given above. As the structures in 17 show, the complexity condition does not allow the /s/ to govern the following consonant.



Since the preceding /s/ has a less complex internal structure than the following segment, it cannot become its governor. Therefore, interconstituent government relations, and not constituent, hold between the two.

clusters

The two different onset types for Raddoppiamento sintattico (cf 10), can be handled in exactly the same manner—where Raddoppiamento sintattico is triggered, the initial consonant forms part of a branching onset, otherwise, the initial consonant constitutes the post-nuclear rhyme position

The different governing relations assigned to the consonant clusters account for why some consonant clusters behave differently from others. There may, however, be doubt concerning the validity of the headless rhyme position. It may seem somewhat ad hoc to posit the initial consonant of the exceptional clusters in headless post-nuclear rhyme position. Specifically, is there justification for the nucleus when nothing is phonetically realized in this position? Indeed, the empty-headed nucleus serves to account for the apparently peculiar behavior of the Italian definite article in 4

As we have seen previously, the examples in 4 all take the *lo* form where its counterpart, *il* is anticipated. The form *lo* appears even though the following words begin with consonant clusters and not vowels. If we consider the initial consonant of each word to affiliate to the rhyme position preceded by a headless nucleus, the reason why the *lo* form appears is clear: the *il* form cannot co-occur with these examples because what follows is actually a nucleus

The exceptional behavior of the definite article justifies our claim of positing an empty nucleus before the initial consonant. The question that we now face is this: why can't the initial consonant be grouped into the onset?

As claimed by Harris (1994: 170), a well-formed onset requires that there be a downward complexity slope between the head and its complement. This means that consonant clusters that display either an upward complexity profile or a level pattern will not be allowed to form complex onsets

The initial consonant of each word in 4a, for example, does not have the potential to govern the following consonant because the number of elements is fewer than that of the following consonant, that is, there is an upward rather than a downward complexity slope (e.g. s[U, ?, h, H] vs p[R, h, H], s[U, ?, h, H] vs k[R, h, H], etc.)

Consequently, the two consonants are in interconstituent relation with the initial consonant linked to the rhyme position headed by an empty nucleus

8 Conclusion

In this paper, we have examined some exceptional cases of consonant clusters in both word internal and word initial positions. These clusters are problematic in view of the maximal approach, but the difference between the general and the exceptional consonant types can all be accounted for by positing constituent government relations for the former and interconstituent relations for the latter. In addition, the existence of the rhyme in word initial position has been justified from the behavior of the Italian definite article before the exceptional type of consonant clusters

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