Italian Word-Initial Consonant Clusters in Optimality Theory

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Despite the attention given to optimality theory (OT), only a small portion of prosodic theory has been addressed under this framework. It is my intention to discuss the implications of OT when it is applied to word-initial consonant clusters in Italian. Davis (1990) describes the restrictions placed on Italian word-initial consonant clusters by outlining syllable formation constraints and a language specific minimal sonority distance which is measured between two adjacent consonants. I n this paper, I demonstrate that OT theory cannot apply a sonority hierarchy (or margin hierarchy).within the onset consitituent. That is, the theory cannot compare two adjacent elements within one constituent. By adding an affinity constraint, possible onsets and possible nuclei can be established under OT. Furthermore, lists of possible C_1s and C_2s can be provided; however, the model cannot ensure that minimal sonority distancing will be fulfilled.

1.0 INTRODUCTION

In recent years Optimality Theory (OT) has become a dominant paradigm within the study of phonology. Despite the attention given to OT, there are many areas of phonology to which it has yet to be applied. A small portion of prosodic theory has been addressed within the optimality paradigm, such as accounting for basic CV syllable structure. However, it seems that more marked syllable structures have not yet been translated into OT. It is my intention to discuss how OT accounts for consonant clusters in word-initial position. In the interest of brevity I will focus on the word-initial consonant clusters in Italian. Davis (1990) explains that initial consonant clusters in Italian can be well described through the use of Steriade's syllable formation rules and a language-specific minimal sonority distance between two adjacent consonants. This proposition is easy to comprehend and emphasizes the explanatory importance of sonority hierarchies in phonology. Translating this solution into optimality theory has proven to be difficult. Optimality theory addresses phonological issues from a different perspective than other current theories such as lexical phonology or autosegmental phonology. Under OT, Universal Grammar consists largely of a set of constraints regarding the well-formedness of language. It will be demonstrated that the inventory of constituents is more restricted under OT. In particular, the onset constituent appears to be impenetrable in OT. A sonority hierarchy can define possible onsets and nuclei

within a language. However, the sonority hierarchy cannot be employed inside the onset constituent within OT.

This paper is organized as follows: in section 2.0, the data set under discussion is presented. Additionally, Davis' (1990) explanation of this data is demonstrated within a rule-governed approach. An explanation of the very basic Italian syllable structure follows in section 3.0. Both CV syllables and the relationship between onsets and nuclei will be outlined within optimality theory, leading to an explanation for word-initial clusters in Italian. In section 4.0 a new constraint is proposed to help account for the minimal sonority distance of Italian consonant clusters. The final tableau demonstrating the OT translation is also presented in this section. Finally, in section 5.0, some of the problems created by an OT analysis for Italian clusters will be included in the summary.

2.0 THE DATA AND PRESENT ANALYSIS

The data set being utilized for this paper was intended to demonstrate the distribution of the definite masculine article allophones in Italian. However, this paper will be addressing this data in a more general manner. Italian possesses the consonant clusters given in (1).

(1) Consonant clusters in Italian
bl, br, pl, fr, dr, tr, kl, kr, gl, gr, pn
(Davis, 1990:43)[1]

Examples of the consonant clusters present in Italian are given below in (2).

(2)

il blocco	'the block'	il braccio	'the arm'
il clima [kl]	'the climate'	il cratere [kr]	'the crater'
il drago	'the dragon'	il flutto	'the surge'
il frutteto	'the orchard'	il globo	'the globe'
il grado	'the grade'	il plotone	'the platoon'
il premio	'the prize'	il traffico	'the traffic'
il pneumatico	'the tire'		

(Davis, 1990:44)[2]

Davis (1990) describes well-formed consonant clusters in Italian by using Steriade's syllable-formation rules in combination with a language specific sonority hierarchy.[3] Instead of maintaining a universal sonority hierarchy, Davis proposes the language-specific sonority hierarchy found in (3).

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[1]Glides are not included in this discussion because their consonantal status is controversial. It appears that glides are treated as vowels in Italian. Additionally, s+C sequences are not dealt with in this paper. See Kaye (1992) for problems reagrding these clusters.
[2]Examples of consonant clusters that are not permitted in Italian were not available. However, Davis (1990) mentions that the list in (2) is an exhaustive list of Italian consonant clusters.
[3]Davis' (1990) proposal focuses on word-initial consonant clusters but it can be easily applied to word-internal clusters as well. Because this paper discusses word-initial clusters only, a description

(3) Italian Sonority Hierarchy

voiceless stops	voiced stops	noncoronal fricatives	coronal fricatives	n	m	liquids	vowels
1	2	3	4	5	6	7	8

(Davis, 1990:45)

Steriade's syllable-formation rules work in conjunction with this hierarchy:

(4) Syllable-formation Rules

a. CV rule: A syllable is created consisting of an onset and a rhyme, where the rhyme consists of a vowel, and the onset consists of the consonant immediately preceding the rhyme.

b. Onset rule: The consonant immediately preceding the onset created in the rule above becomes a member of the onset. However, this is subject to a language-specific minimal sonority condition. In Italian, the minimal sonority distance is four.

(Davis, 1990:46)

In other words, if two adjacent consonants in word-initial position do not have a minimal sonority distance of four (based on Davis' (1990) scale) then that consonant cluster will not be permitted word-initially in Italian.

3.0 BACKGROUND OPTIMALITY THEORY

In order to meaningfully translate the Italian consonant cluster sonority hierarchy into OT, basic syllable structure and sonority hierarchies within OT must also be outlined.

3.1 Italian in Basic Optimality Theory

Before the translation of well-formed consonant clusters can be discussed, it is necessary to outline the very basics of the syllable structure of Italian within OT. This preliminary analysis will include only simple onsets, and not Italian consonant clusters. Prince and Smolensky (1993) outline eight basic syllable structure constraints that are necessary for characterizing a language's prosodic structure.

(5) **ONS**
Syllables must have onsets.

(6) **-COD**
Syllables must not have codas.

(7) **PARSE**
Underlying segments must be parsed into syllable structure.

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of word-medial clusters will not be presented.

(8) **FILL**
Syllable positions must be filled with underlying segments.

(9) **NUC**
Syllables must have nuclei.

(10) ***COMPLEX**
Mo more than one C or V may associate to any syllable position.

(11) ***M/V**
V may not associate to Margin nodes (Ons and Cod).

(12) ***P/C**
C may not associate to Peak (Nuc) nodes.

Prince and Smolensky (1993) maintain that the four constraints listed above in (5) to (8) can be relatively ranked in any dominance order for any particular language. These are applied to Consonant-Vowel (CV) strings within a given language. The constraints in (9) to (12) parse the CV strings into syllables. These constraints are universally fixed in superordinate positions relative to the constraints in (5) to (8).

Prince and Smolensky (1993) propose the following order of constraints for a language which requires nuclei but has both optional onsets and codas.[4] Disregarding branching onsets, this is the set of constraints that apply in Italian.

(13) **(NUC,*COMPLEX,*M/V,*P/C) »PARSE »FILL »ONS »-COD**[5]

Codas and onsets are optional in Italian, hence both **PARSE** and **FILL** dominate **ONS** and **-COD**, . Since the coda position is not of concern in this paper, it will no longer be included in the discussion. However, the other three constraints, **PARSE**, **FILL**, and **ONS**, are necessary for an account of consonant clusters in Italian, as will be demonstrated below.

3.2 The Onset-Nucleus Relationship

This section provides a portion of the background optimality theory necessary to translate Italian consonant clusters into OT. Prince and Smolensky (1993) focus their discussion of onset-nucleus relationships within OT on Berber syllabification. In Berber, any segment except for [t] can appear as the nucleus of a syllable. In order to explain Berber syllabification, Prince and Smolensky (1993) use the nuclear harmony constraint.

[4]See Prince and Smolensky (1993) for details on why this particular ranking of constraints is required.
[5]Because vowels are not a concern in this paper, 'V' represents all vowels in the constraints being described.

(15) The Nuclear Harmony Constraint (**HNUC**)

A higher sonority nucleus is more harmonic than one of lower sonority. This constraint picks out the most sonorous element possible to be the nucleus of a Berber syllable, in relation to all of the other constraints utilized for Berber syllabification. For a language such as Italian, where vowels make up a large majority of nuclei, **HNUC** is too binding; not all segments can appear as nuclei and not all segments can appear as margins. What is more appropriate in the context of Italian is a more specific sonority hierarchy much like that proposed by Davis (1990) in section 2.0. In OT, the hierarchy takes a slightly different shape. The OT sonority hierarchy for onsets in Italian can be depicted in two forms which are found in (16).[6]

(16a) Margin Hierarchy
***M/V » *M/r » *M/l » *M/m » *M/n » *M/f » *M/d »*M/t**

(16b) Peak Hierarchy
***M/t » *M/d » *M/f » *M/n » *M/m » *M/l » *M/r » *M/V**

The first set of constraints simply lists the segments which can appear in onset position from the least harmonic candidate to the most harmonic candidate. The second set lists the least harmonic to most harmonic peak position elements.

Prince and Smolensky (1993) explain that one of the most important questions regarding the relation between individual segments and syllable position is the following: for any given segment, is the association to a peak or to a margin? Prince and Smolensky propose another constraint to answer this question.

(17) Syllable Position Affinity
If in a given language P/X > M/X, or equivalently *M/X » *P/X, then X is a peak-preferring segment; otherwise X is margin preferring.

Those elements appearing as onsets and those appearing as peaks are formally separated by the constraint in (18).

(18) **Affinity Parameter**

π_{Aff} is located as follows between two adjacent sonority levels, that of the most sonorous margin-preferring segment and that of the least sonorous peak-preferring segment:

$$\max_r \{|r|: *P/r » *M/r\} < \pi_{Aff} > \min_V \{|V|: *M/V » *P/V\}$$

[6]Peak and margin harmonies are also possible alternatives but are not necessary for the purposes of this paper.

In other words, the most sonorous margin in Italian, /r/, and the least sonorous peak, /V/, are separated by π_{Aff}. The Affinity Parameter divides the sonority hierarchy into possible onsets and possible nuclei.

With this understanding of constraints regarding onset-nucleus relationships, it is now possible to provide an explanation for the appearance of word-initial consonant clusters in Italian.

4.0 A POSSIBLE SOLUTION

How then, can consonant clusters requiring a minimal sonority distance be incorporated into the optimal Italian syllable? It seems reasonable to begin by examining the basic syllable structure constraints in (5) to (12). ***COMPLEX** in (10) claims that only one C or V may be associated with any syllable node. Further, Prince and Smolensky (1993) state that this constraint is fixed in a superordinate position in relation to the other constraints mentioned. In order to include consonant clusters in the Italian well-formed syllable constraints, ***COMPLEX** will have to be ranked fairly low in relation to the other constraints involved since branching onsets cannot be permitted in a given language otherwise.

With ***COMPLEX** lowly ranked, it is now possible to permit two consonants in the onset position. However, this does not restrict how these consonant clusters may appear in a given language. For example, both [bl] and [nl] would be permitted under the present system, where only [bl] is a possible cluster in Italian. It is necessary to design a way in which a minimal sonority distance of four can be achieved within OT. At first glance, this problem seems nearly impossible to solve. There is a large gap between the constraints **HNUC** and **Margin Hierarchy**. Under OT it seems that the simplest language descriptions result from the two extremes: complex structures such as syllables in Berber, and simple CV syllable structures. However, a solution is possible if a new constraint is created using an analogy with onset-nucleus relationships. Recall the **Affinity Parameter** outlined in (18). This constraint defines the possible onsets and nuclei in a given language. This is exactly the type of restriction required to define the permissible consonant clusters of Italian. It is necessary to separate the consonants (C_2C_1) which are permitted to appear in C_1 position from those that can appear in C_2 position. The π_{Aff} is said to appear between two sonority levels. Another **Affinity Parameter** must be posited in order to explain consonant clusters. Further, this second **Affinity Parameter** is more restricted than the first; this second constraint may only exist in the presence of a consonant cluster.

(19) **Affinity Parameter for Consonant Clusters**

π_{Aff} is located as follows between two adjacent sonority levels, that of the most sonorous leftmost margin-preferring segment and that of the least sonorous rightmost margin-preferring segment:

$$\max_t \{ltl: *M_1/t \gg *M_2/t\} < \pi_{Aff} > \min_n \{lnl: *M_1/n \gg *M_2/n\}$$

With this constraint in place, the OT constraints for Italian consonant clusters would take the following order:

(20) **PARSE , FILL} » *P/C_2 , *M/V » *P/C_1 » *M/C_1 » *M/C_2 » *COMPLEX » *P/V**[7]

In the tableau in (22), the constraints for Italian consonant clusters are applied.

(22) Tableau for initial cluster in Italian *blucco*, 'block'[8]

/blV/	Parse	Fill	*P/b	*M/V	*P/l	*M/l	*M/b	*COM PLEX	*P/V
+blV́						*	*	*	*
bolV́		*!				*	*		*
‹b›lV́	*!					*			*
óblV́		*!				*	*	*	*
bĺV				*!	*		*		
B̀lV́			*!			*			*

In what follows, the motivation behind the ranking of these constraints will be presented. Additionally, a brief explanation of the violations for each candidate is offered.

The constraints, **PARSE** and **FILL**, must be ranked highly because both deletion and epenthesis are not permitted in Italian consonant clusters. Following these constraints are ***P/C_2(b)** and ***M/V** which demonstrate that [b] is a poor peak and vowels should not appear in onset position. ***P/C_1(l)** is dominated by ***P/C_2(b)** and ***M/V** because it is more preferred to have [l] in a peak position than to have [b] in a peak position or a vowel in a margin position. The ordering of ***M/C_1(l)** and ***M/C_2(b)** is crucial to this analysis. It is preferable to have a less sonorous consonant in the margin position, therefore the more sonorous consonant must have a higher ranked constraint than the less sonorous consonant. Further, the **Affinity Parameter for Consonant Clusters** is activated due to the presence of a consonant cluster. This constraint separates [b] and [l] into the correct C_1 and C_2 positions. The constraint, ***COMPLEX**, is dominated by all of the above constraints, given that consonant clusters appear. Finally, ***P/V** is of very little importance in comparison to the rest of the constraints because vowels in peak positions are optimal.

With an understanding of the motivation for this particular set of constraints, each candidate's crucial violation (!) may be briefly discussed. The candidates will be addressed beginning at the top of the tableau with the bottom candidate being discussed last. The optimal candidate (represented by an apple), blV́, only violates

[7]Obvious constraints are not included in this ranking of constraints. Only relevant constraints are discussed.

[8]These consonant clusters are assumed to be tautosyllabic and will not be discussed in this paper.

the lowest constraints within the set. As such, these constitute very minimal violations. The second candidate, b´lV́, has an empty nucleus violating **FILL**, which is among the highest ranked constraints in this set because Italian does not permit deletion. **PARSE** is violated by the third candidate, ‹b›lV́, which is also one of the highest ranked constraints since epenthesis does not occur in Italian. The fourth candidate, ´blV́, has a crucial violation similar to the second candidate; it violates **FILL**. ***M/V** is crucially violated by the fifth candidate, bĹV, because the vowel appears in a margin position. Also notice that ***P/l** is violated by this candidate. Finally, B́lV́, the sixth candidate, crucially violates ***P/b** which is the third highest ranked constraint. These violations demonstrate that the above ranking of constraints creates the correct surface structure for an Italian consonant cluster. Unfortunately, this application of OT is not without problems.

5.0 DISCUSSION AND SUMMARY

Presently in optimality theory, a sonority hierarchy is considered useful in deciding what position is most harmonious for a particular segment. For example, a sonority hierarchy can be employed within OT to demonstrate why [t] makes a poor nucleus yet makes an optimal onset in most of the world's languages. Further, OT can explain why one nucleus is better than another, within a possible set of nuclei. However, OT cannot employ a sonority hierarchy (or margin hierarchy in this case) within a given constituent. In other words, the theory cannot compare two adjacent elements within one constituent. This problem is apparent when attempting to translate minimal sonority distance requirements for consonant clusters within the onset of a syllable. Even when an affinity constraint as in (19) is created, the problem cannot be solved entirely. The minimal sonority distance in Italian is four, based on the scale in (3). This scale is relational: [p] can appear with [l], however, [f] cannot appear with [l] because four segmental levels do not appear between [f] and [l]. In OT, lists of possible C_1s and C_2s can be provided, however, the model is not robust enough to ensure that the minimal distance will be fulfilled. It remains unclear how this problem should be approached.

Overall, the OT analysis of Italian consonant clusters does not possess the simplicity and explanatory power of Davis' (1990) proposed solution. Optimality theory has great potential in explaining a large amount of phonological phenomena. However, explaining the finer details of areas such as prosodic structure needs refinement.

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