# CHAPTER 2

# THE ONSET TYPOLOGY

## 2.1 Introduction

The study of obstruent clusters to be presented in the following chapters has two main objectives. On the one hand, it intends to provide new empirical information that can contribute to an understanding of the principles that govern the phonotactics of obstruent clusters in onset position. On the other, by understanding such principles, the dissertation aims to present a new and original analysis of one particular type of obstruent clusters, i.e. s+STOP.

In this chapter, I provide a discussion of the methodology used in the data collection. I then turn to the generalizations observed on the manner dimension for obstruent clusters occurring in onset position. This is the dimension where the feature [continuant] is relevant. On this dimension, the relative harmony of each individual type of obstruent cluster as well as their relative well-formedness and co-occurrence restrictions are captured. In this chapter, I argue that the markedness relationships among the different types of clusters are responsible for the co-occurrence restrictions observed across languages.

The second dimension that will be of interest is the place dimension. On this dimension, restrictions on place features within a cluster are captured. Place generalizations are discussed in Chapter 4.

The third dimension that is relevant to obstruent clusters is the dimension of laryngeal features, i.e. voicing, glottalization and aspiration. I will not be concerned with laryngeal features in this dissertation since they are a well understood aspect of obstruent clusters in the linguistic literature (Lombardi 1991, 1995a, 1995b, 1998; Steriade 1997 and references cited therein).

Finally, in this dissertation I only concentrate on obstruent clusters occurring in onset position. A preliminary investigation of obstruent clusters occurring in coda position has shown that this is indeed not as simple a task as for obstruent clusters occurring in onset position. One of the main problems is that codas are, in general, more restrictive syllable positions than onsets. Consequently, languages that allow obstruent clusters in their coda positions are less common than languages that allow clusters in their onsets. In particular, out of the about 30 languages used in the onset typology, only a very small number (about 5) could have been used for generalizations in the coda. Moreover, codas present the additional problem of weight and extrasyllabicity, which makes a consistent analysis of the data quite difficult. As a matter of fact, two different types of generalizations would be necessary. One type would concern those clusters that are clearly not extrasyllabic in the case of quantity sensitive languages, whereas another would concern quantity insensitive languages in which extrasyllabicity is not an issue. For this reason and due to the scarcity of the data, the present study concentrates solely on onset clusters.

### 2.2 Methodology

In order to establish consistent criteria for the typological study of obstruent clusters, I have considered the following issues:

- What constitutes an obstruent cluster?
- What is the status of affricates?
- Are certain sequences to be interpreted as single units or clusters?
- How should a representative sample of languages be created?
- Should the generalizations be stated in terms of word or syllable boundaries?
- Are morphologically complex words representative of the language's phonotactics?
- What about non-native vocabulary?

The following sections will discuss each individual question separately and provide information on the criteria established in each case.

#### 2.2.1 Obstruent Clusters: Definition

Obstruent clusters in this study are defined as **tautosyllabic[1] sequences of stops (S) and fricatives (F)**. The study is restricted to two member sequences, because longer obstruent clusters are much rarer, and it is not always clear whether such sequences constitute examples of minor syllables, i.e. syllables containing a syllabic consonant or a consonant followed by a transitional vowel, or pure

[1] The generalizations are restricted to tautosyllabic clusters. Heterosyllabic clusters may indeed reveal a whole different set of generalizations that are not covered in this study.

consonant clusters.

Obstruent clusters can consist of a fricative and a stop in either order, or of a sequence of two fricatives or two stops. Representative examples of the different types of obstruent clusters are given below:

- FS (e.g. English /st/, Havasupai /θp/, Haida /ɬk/, German /ʃt/)
- SF (e.g. Wichita /ks/, Paipai /px/)
- FF (e.g. Italian /sf/ , Nisqually /sχ/)
- SS (e.g. Khasi /pt/, Georgian /tpʰ/)

The obstruent clusters given above represent the four logical ways in which fricatives and stops can cluster. The four possible clusters are all attested across languages.

### 2.2.2 The Status of Affricates

In his study whose focus was to construct generalizations about various types of consonant clusters, Greenberg (1978) considers affricates as clusters of a stop+fricative. Unlike Greenberg, I consider affricates as single segments and, consequently, I don't consider them instances of SF clusters. As a matter of fact, recent research in feature geometry (Sagey 1986), (Lombardi 1990), has shown that affricates can best be represented as a single root node with two value specifications for the feature [continuant]. Lombardi (1990) presents a number of facts about the affricate that indicate its status as a single segment. In particular, affricates contrast not only with stops and fricatives but also with clusters. For example, in Polish the cluster [tʃ] contrasts with the affricate [č] as in the following examples from Campbell (1974):

(1) trzy [tʃt] "three"

czy [čt] "whether"

Affricates also pattern with single segments in syllabification. Chipewyan, for example, only allows simple onsets. Affricates occur in onsets, which suggests that they must be single segments themselves.

Affricates are, moreover, treated as single segments by reduplication processes. For example, in Ewe (Ansre 1963) there is a process of reduplication that copies only the first consonant of a consonant cluster in the root, as shown in example (2a). If the root contains an affricate, the affricate is copied in its entirety, as in examples (2b) and (2c).:

| | | | | | |
|---|---|---|---|---|---|
| (2) | a. | fle | fefle | "buy" | |
| | b. | ci | cici | "grow" | *tici |
| | c. | dzra | dzadzra | "sell" | *dadzra |

In addition, affricates are never affected by epenthesis or metathesis processes. For example, in Hebrew (Bolozky 1980) the cluster [ts] and the affricate [c] contrast. Whereas the cluster can be broken up by an epenthetic vowel in careful speech, the affricate can never be broken up in the same way:

| | | | |
|---|---|---|---|
| (3) | /tsumet lev/ | [təsumet lev] | "attention" |
| | /cilum/ | *[təsilum] | "photograph" |

Under the view that affricates are single segments, therefore, an affricate does not constitute an obstruent cluster by itself since clusters are, by definition, sequences of two distinct root nodes. Affricates, however, can be one of the members of an obstruent cluster, and thus combine with either fricatives or stops to form a cluster, depending on the language[2].

### 2.2.3 SF Sequences: Clusters or Singletons?

For most of the languages considered, the status of affricates was uncontroversial in the sources consulted. However, for the few controversial cases, I decided on the status of certain SF clusters in part on the basis of the facts discovered in the present dissertation for obstruent clusters. For example, in the case of German, where researchers disagree on the status of homorganic [ts], [tʃ], and [pf], I have favored the affricate analysis for these three segments on the basis of the place restrictions observed for true obstruent clusters in the language[3]. In the case of languages with both homorganic as well as non-homorganic SF sequences, such as [ks], [kʃ], [tf], [kɬ], [ps], I interpret both types of sequences as clusters. According to Lombardi (1990), whereas tautosyllabic clusters tend not to share place, the two parts of an affricate must share place.

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[2] Assuming Lombardi's proposal (1990) that the [-cont] and [+cont] components of an affricate are unordered throughout the phonological representation, the system I propose predicts that an affricate can form a clusters with a stop or a fricative depending on what types of obstruent clusters the language allows in the case of simplex segments. For example, in Nisqually in Chapter 3, I show that the ranking that disallows a stop+stop cluster also disallows an affricate+stop cluster.

[3] See the analysis of German in Chapter 4.

Along the same line, the choice of treating sequences of SS, SF or FF as clusters rather than single segments in the languages sampled in the study depended mostly on the presence of phonological evidence that would support their status as clusters rather than single segments.

### 2.2.4 The Sampled Languages

The data was collected from a sample of about 30 languages representative of a number of different language families. Language families represented in the study ranged from Indo-European, to Caucasian, Dravidian, Austroasiatic, Afroasiatic, Tibeto-Burman and Amerindian languages. The Niger-Congo family is represented as well with Eggon. Eggon is indeed an exceptional language in this family because Niger-Congo languages typically disallow consonant clusters. These languages are usually characterized by open syllables. If clusters are allowed, they are generally limited to a few types, such as nasal+obstruent or obstruent+liquid. Eggon, on the other hand, allows obstruent clusters of the FS, SF and SS type (Maddieson 1981).

To make this small sample of languages as representative of the world's languages as possible, I tried to span across as many language families as possible rather than stay within a few well documented language families. Although concentrating on Indo-European or Amerindian families, for example, would have increased the number of languages in the typology, since obstruent clusters are relatively common across these language families, I don't believe it would have contributed to the understanding of universal phonotactics. The languages considered, with their language families are indicated in the following:

(4)

| Indo-European |
| --- |
| Germanic: German, Dutch, English<br>Romance: Italian<br>Hellenic: Greek (Attic, Modern)<br>Slavic: Serbo-Croatian<br>Baltic: Lithuanian<br>Indo-Iranian: Pashto, Hindi |
| **Caucasian** |
| Georgian |
| **Austro-Asiatic** |
| Mon-Khmer: Cambodian, Khasi |
| **Tibeto-Burman** |
| Qiang: Mawo<br>Tibetan: Ladakhi |
| **Dravidian** |
| Central Dravidian:Telugu |
| **Austronesian** |
| Tsou |
| **Niger-Congo** |
| Eggon |
| **Afro-Asiatic** |
| Semitic: Modern Hebrew |

| Amerindian |
| --- |
| Salish: Nisqually<br>Siouan: Dakota, Yuchi<br>Caddoan: Wichita<br>Hokan: Seri<br>Tsimshianic: Nisgha<br>Yuman: Havasupai<br>others: Haida<br>Misantla Totonac<br>Yatee Zapotec |

### 2.2.5 Syllable Onsets

Since this study is only concerned with tautosyllabic obstruent sequences, the majority of the data was collected from clusters occurring in word-initial position, but not restricted to them. In some languages, such as Modern Greek, where syllabification of medial clusters is ambiguous, the generalizations observed at the margins proved to hold also in word medial position. For this reason, I have chosen to talk about onset obstruent clusters rather than word initial clusters. Moreover, the arguments provided for the view that obstruent clusters in initial position are extrasyllabic are not always compelling. As I will argue later for Italian, the fact that medial obstruent clusters are syllabified heterosyllabically, does not necessarily mean that word-initially they must be heterosyllabic as well. In other words, I show that the arguments for the heterosyllabicity of word-initial obstruent clusters do not indeed provide evidence for the extrasyllabicity of word initials.

### 2.2.6 Morphologically Complex Clusters

Most of the data in the study represents generalizations drawn from monomorphemic words. Clusters resulting from morpheme concatenation can provide information about the phonotactics of simplex words. If a language consistently tolerates certain clusters that result from affixation, it may indeed mean that in that language those clusters are well-formed. If they were ill-formed we would expect some phonological process to apply to repair the offending sequence. This is the case of many Tibeto-Burman languages in which a very large number of clusters are derived via affixation. On the other hand, however, one must be wary of the possibility that such clusters may, indeed, be ill-formed in monomorphemic words, but can survive in polymorphemic words for some other independent morphological reason. I argue, in Chapter 5, that this is the case for s+fricative clusters in Italian. Decisions on this issue were made on a language particular basis.

### 2.2.7 Non-native Phonotactics

Another important issue in the interpretation of the data was to decide whether borrowed words with unusual clusters, or clusters that appeared only in one stratum of the vocabulary of clear foreign origin, should be considered as part of the cluster inventory of the language. Whenever possible, only clusters from words belonging to the native vocabulary were considered as part of the cluster inventory of the language. For example, in languages with clusters present only in words of clear foreign origin, or in words belonging to a particular lexical stratum of non-native origin, such clusters were considered marginal and thus not necessarily relevant for classificatory purposes. The true properties and universals of cluster inventories can only be captured if a clear distinction is made between native, and therefore productive, and non-native, and therefore non-productive, consonant clusters. Considering clusters that are not part of the native inventory as part of the whole inventory of the language would only contribute to a description of the language rather than lead to an understanding of the universal properties of language.

In the section that follows I present the generalizations that emerge from the cross-linguistic study. The section focuses on the manner dimension in onset clusters. It contributes to the understanding of the principles underlying co-occurrence restrictions of the various types of obstruent clusters.

## 2.3 Onset Generalizations

The four possible types of obstruent clusters, i.e. FS, FF, SF and SS, give rise to 15 possible ways in which such clusters can either occur in isolation or co-occur in the world's languages. Table (5) below lists all the logically possible patterns in which obstruent clusters can occur across languages. Of these patterns, only six are shown to occur in the onset in the languages that I have investigated. A check under the onset column indicates that the pattern on the right was found.

(5)

| Patterns of Occurrence | Onset |
|---|---|
| 1. FS | ✓ |
| 2. FF | |
| 3. SF | |
| 4. SS | |
| 5. FS FF | ✓ |
| 6. FS SF | ✓ |
| 7. FS SS | |
| 8. FF SF | |
| 9. FF SS | |
| 10. SF SS | |
| 11. FS FF SF | ✓ |
| 12. FS FF SS | |
| 13. FS SF SS | ✓ |
| 14. FF SF SS | |
| 15. FS FF SF SS | ✓ |

As the table shows, there is only a limited number of ways in which these clusters can either occur in isolation or co-occur in the world's languages. Out of the 15 possible ways in which inventories of onset obstruent clusters of length two can be constructed, only six ways are attested to occur across languages. The following table shows the six different language types[4] and the clusters allowed for each type.

(6)

| | FS | SF | SS | FF |
|---|---|---|---|---|
| *Type 1* | ✓ | | | |
| *Type 2* | ✓ | | | ✓ |
| *Type 3* | ✓ | ✓ | | |
| *Type 4* | ✓ | ✓ | | ✓ |
| *Type 5* | ✓ | ✓ | ✓ | |
| *Type 6* | ✓ | ✓ | ✓ | ✓ |

Languages of *Type 1* only allow fricatives in initial position and only stops as the second member of the cluster. Examples of *Type 1* languages are English (Kenstowicz 1994), Haida (Swanton 1910; Sapir 1922), Havasupai (Seiden 1963; Hinton 1984), Hindi (Nagamma Reddy 1987), Isthmus Zapotec (Marlett and Pickett 1987), Italian (Nespor 1993), Mazateco (Pike and Pike 1947; Steriade 1994), Mislanta Totonac (MacKay 1994), Modern Greek (Joseph and Philippaki-Warburton 1987) Telugu (Nagamma Reddy 1987) and Yuchi (Wolff 1948; Crawford 1973). *Type 2* languages allow both stops and fricatives to follow an

[4] The exceptions to these generalizations will be discussed in Section 2.5.2

initial fricative. Dutch (De Schutter 1994) belongs to this class of languages. The languages of *Type 3* allow both fricative and stop combinations in either order. No combinations of two fricatives or two stops are allowed. An example of a *Type 3* language is Wichita (Rood 1975). *Type 4* languages allow combinations of fricatives and stops in either order, and sequences of two fricatives as well. There are no clusters containing two adjacent stops. Nisqually (Hoard 1978), Paipai (Joel 1966; Wares 1968) and Pashto (Penzl 1955) belong to this group of languages. Unlike languages of *Type 4*, *Type 5* languages only disallow a sequence of two adjacent fricatives. Fricatives and stops can combine freely without any restriction on the order of occurrence. *Type 5* languages are Attic Greek (Steriade 1982), Dakota (Boas and Deloria 1976) and Khasi (Henderson 1976). Finally languages of *Type 6* allow all four logical possibilities. There are no restrictions on the relative order of combinations of fricatives and stops as well as on sequences of segments belonging to the same natural class. Georgian (Vogt 1971; Deprez 1988; Chitoran 1994), Seri (Marlett 1981, 1988), Serbo-Croatian (Hodge 1946), Tsou (Wright 1996) and Yateé Zapotec (Jaeger and Van Valin 1982) belong to this group of languages.

The typology above shows that languages which only allow one type of combination always allow a sequence containing a fricative and a stop, in this exact order. FS is the only cluster that can occur in isolation, it is always present and the presence of other types of combinations always implies its presence. The presence of a sequence of two fricatives always implies the presence of FS sequences, but it seems to be independent of the other two types of clusters, i.e. SF and SS. However, the presence of SF clusters does imply the presence of FS, but does not imply the presence of either FF or SS. SS sequences imply the presence of SF sequences, and consequently the presence of FS clusters. There seems to be no implicational relation between FF and SS clusters, as well as between FF and SF clusters. These implications are schematized in the following diagram:

(7)

SS<br>⇓<br>SF<br>⇓<br>FF ⇒ FS

In figure (7), implications are shown to exist between SS and SF, SF and FS and by transitivity SS and FS. Assuming implications as a means to determine markedness, the following markedness relations can be established

(8)

FS → FF<br>↓<br>SF<br>↓<br>SS

Diagram (8) shows the markedness relations among the four types of clusters, with FS being the least marked and SS being the most marked given the fact that its presence not only implies the presence of FS clusters but also the presence of

SF clusters. The diagram also shows no relation between FF clusters and SF or SS clusters. The existence of markedness relations derived by implicational universals suggests that any analysis of this kind of clusters must be able to provide a principled account of such an issue.

In the next section I will briefly discuss the inadequacy of sonority as a parameter to account for the generalizations represented here. I argue that sonority is not relevant to obstruent clusters since it fails to account for both markedness relations and implicational universals of onset obstruent clusters.

## 2.4 Sonority and the Typology

Let us first consider a scale in which obstruents are broken down into stops and fricatives, with stops being less sonorous than fricatives as commonly assumed:

(9) F > S

Given this scale, the SSP would predict the well-formedness of SF clusters and the ill-formedness of FS clusters with respect to sonority. In other words, it would predict that SF clusters should not only be quite common, or at least more common than FS clusters, which would constitute a violation of the SSP, but also that SF should be the unmarked case along the sonority dimension. Thus, we would expect to find both languages with only SF clusters, as well as languages where the following implication holds:

(10) FS $\Rightarrow$ SF

If a language has FS clusters, then it has SF clusters.

However, as the typology shows, there are no languages which behave in this way. On the contrary, FS clusters, but not SF clusters, can be found in isolation, and SF always implies the presence of FS, thus making (10) false. As discussed in section 2.2, I argue that FS and not SF is unmarked, which is a reasonable conclusion given the fact that FS clusters are quite common across languages, much more common than SF clusters. A scale which assigns a higher sonority rank to fricatives is, therefore, highly problematic for an account of the typology of onset obstruent clusters and its implicational universals under a sonority-based approach.

Let us explore now the possibility of a scale opposite to (11), i.e. a scale in which stops would be more sonorous than fricatives:

(11) S > F

Although there is no independent evidence for such a scale, the typology presented in this dissertation would motivate it, since it would allow us to predict some of the generalizations observed. In other words, under this scale the existence of languages with only FS clusters but not SF and the implication SF ⇒ FS would be completely predictable. However, such a scale would still be unable to explain other facts about obstruent clusters. In particular, this scale would be unable to explain the implications FF ⇒ FS and SS ⇒ SF. Sonority cannot therefore be invoked to account exhaustively for the generalizations which emerge from the typology of obstruent clusters.

### 2.5 Analysis of the Generalizations

In the sections that follow, I will analyze these facts at two separate levels of abstraction. I will first discuss the markedness relations that hold among the four types of clusters and how we can formally derive these relations in OT. I will then discuss the factorial typology and the implicational universals that follow from the constraints proposed to account for the markedness relations among the different types of obstruent clusters. Finally, I will provide a discussion of the *Harmonic Bounding Argument* and show how this procedure of analysis can account for what clusters count as well-formed or ill-formed under a particular constraint ranking.

#### 2.5.1 Harmonic Orderings or Markedness Relations

The markedness relations schematized in (8) in section 2.3 directly translate to the following harmonic orderings:

(12) a. FS $\succ$ FF

b. FS $\succ$SF $\succ$SS

To establish the orderings in (10), I propose the following set of markedness constraints:

(13) OCP[-cont]

Tautosyllabic [-continuant] segments are disallowed.

(14) OCP[+cont]

Tautosyllabic [+continuant] segments are disallowed

(15) *SO

A tautosyllabic sequence containing a stop followed by any obstruent is disallowed.

Constraint (15) is a negative constraint, which disallows tautosyllabic sequences of a stop and any obstruent, either a fricative or a stop. It is justified both phonetically and phonologically. Phonetically, it reflects the preference for stops to be released into more sonorous segments. Phonologically, it allows us to assign SS clusters a proper superset of the marks assigned to SF clusters and thus derive the ordering SF $\succ$ SS. A similar constraint is proposed in Steriade (1994). This constraint will prove crucial in the analysis of obstruent clusters in Modern Greek.

Constraints (13) and (14) are two separate OCP constraints (Leben 1973; Goldsmith 1979; McCarthy 1986; Yip 1988; Odden 1988). They are formulated over each value of the feature [continuant] and state, respectively, that SS or FF sequences are disallowed. The two OCP constraints, as well as the sequential markedness constraint in (15), apply within tautosyllabic clusters. The reason for specifying the domain of application of these constraints lies in the fact that the generalizations that hold for tautosyllabic obstruent clusters may not necessarily hold for heterosyllabic clusters as well.

The relative harmony of the four different types of obstruent clusters is obtained by evaluating them against the three structural constraints given above. Evaluation of the different obstruent clusters is given in tableau (16). The three structural constraints are universally unranked with respect to each other and the relative harmony of the different clusters is obtained via the strategy of analysis to determine universal harmonic orderings introduced in Chapter 1, which I referred to as the *Subset Strategy*.

(16)

| | OCP[+cont] | *SO | OCP[-cont] |
|---|---|---|---|
| a. FS | | | |
| b. FF | * | | |
| c. SF | | * | |
| d. SS | | * | * |

Along the dimension of onset obstruent combinations, FS is the most harmonic of all the cluster types with respect to this constraint system because it receives no marks at all. FS is provably the unmarked cluster type along the dimension of obstruent clusters. FF and SF are less harmonic, and hence more marked, than FS clusters because both clusters are assigned a mark that FS does not receive. In particular, FF is marked with respect to OCP[+cont] and SF is marked with respect to *SO. The marks that FF and SF receive are not identical, therefore there is no harmonic ordering between the two clusters. In this respect, harmony differs from markedness. Whereas the two clusters, FF and SF, can be said to be equally marked because they both imply the least marked cluster FS, they however cannot be said to be equally harmonic because they do not receive identical marks. No relative harmony can therefore be established between FF and SF. Harmonic ordering, on the contrary, exists between SF and SS. SS is less harmonic than SF because the list of marks of SS includes all of the marks assigned to SF plus one, i.e. the mark assigned by OCP[-cont]. Note that, since the list of marks of FS is empty, than FS is obviously more harmonic than SS, as well as SF.

### 2.5.2 The Factorial Typology and the Implicational Universals

By interleaving the markedness constraints proposed in the previous section (OCP[+cont], OCP[-cont], *SO) with Faithfulness, the full typology of onset obstruent clusters is obtained as well as its implicational universal. The following table provides a unified picture that illustrates the re-ranking of the constraints in the six different grammars.

(17)

| LANGUAGE TYPES | CONSTRAINT RANKINGS |
|---|---|
| *Type 1*: FS | OCP[+cont] OCP[-cont] *SO >> Faith |
| *Type 2*: FS-FF | _____ OCP[-cont] *SO >> Faith >> **OCP[+cont]** |
| *Type 3*: FS-SF | OCP[+cont] OCP[-cont] ___ >> Faith >> ***SO** |
| *Type 4*: FS-SF-FF | _____ OCP[-cont] ___ >> Faith >> **OCP[+cont] *SO** |
| *Type 5*: FS-SF-SS | OCP[+cont] ____ ___ >> Faith >> **OCP[-cont] *SO** |
| *Type 6*: FS-SF-FF-SS | Faith >> **OCP[+cont] OCP[-cont] *SO** |

The ranking for *Type 1*, where Faithfulness is dominated by the three structural constraints, allows only FS clusters to surface. FS is the unmarked cluster with respect to all structural constraints, therefore whatever ranking is established, it will always surface. However, in order to prevent inputs containing ill-formed clusters to surface it is necessary that the structural constraints dominate Faithfulness.

*Type 2* languages allow FS as well as FF clusters. FS will surface regardless of the ranking, given its unmarked status. However, in order to allow FF clusters in a language it is necessary that OCP[+cont] be ranked below Faithfulness. OCP[-cont] and *SO must dominate Faithfulness to assure that inputs of the form SF and SS do not surface.

*Type 3* languages allow FS and SF sequences. Once again, FS will surface regardless of the ranking. For SF to surface it is necessary that *SO be ranked below Faithfulness. OCP[-cont] and OCP[+cont] must be ranked above Faithfulness to avoid that inputs of the form SS and FF can surface.

For FS, SF and FF to surface in languages of *Type 4*, *SO as well as OCP[+cont] must be ranked below Faithfulness. OCP[-cont] must dominate Faithfulness to prevent an input of the form SS to surface in the language.

In *Type 5* languages, *SO and OCP[-cont] must both be ranked below Faithfulness in order to admit SF and SS clusters together with the unmarked cluster FS. In this languages, FF clusters do not surface given that OCP[+cont] dominates Faithfulness.

Finally, for all four cluster types to surface in a grammar it is necessary that Faithfulness be ranked above the three structural constraints. This ranking assures that all four cluster types can surface faithfully in the grammar and thus form well-formed clusters.

Using the *Technique of Necessary and Sufficient Conditions* (Prince and Smolensky 1993), the implicational universals observed in the typology follow directly from entailment considerations on the rankings established to admit the relevant clusters in the inventories of the typological languages. First consider the cluster FS, this is unmarked with respect to all constraints in the hierarchy, therefore whatever ranking is established it will always have an optimal output parse. As for the cluster FF, the necessary and sufficient condition that allows it to surface in a grammar is that Faith >> OCP[+cont]. This ranking, however, also entails that FS will surface given its unmarked status. To allow SF in a grammar, instead, it is necessary that Faith >> *SO. This ranking entails that FS will also surface, but does not entail that FF will surface, as expected given the fact that there is no implication holding between SF and FF. Finally, for SS to be admitted in a grammar it is necessary that Faith >> OCP[-cont], *SO. However this ranking entails that SF will also be admitted in the same grammar, since the ranking Faith >> OCP[-cont], *SO entails the ranking Faith >> *SO. The ranking established for SS therefore assures that the same grammar admits SS as well as SF. In other words, given these logical entailments, there is no grammar that allows SS but not SF or FS, or FF but not FS. The system proposed in this dissertation can never give rise to a language in which the implications in (7) do not hold. In other words, the constraint system proposed will admit only *harmonically complete* languages.

### 2.5.3 Harmonic Completeness

According to Prince and Smolensky (1993), "harmonic completeness means that when a language admits forms that are marked along some dimension, it will also admit all the forms that are less marked along that dimension" . The constraint system proposed, thus, only admits *harmonically complete* languages. This is to say that the typology defined by the constraints proposed has the *Strong Harmonic Completeness* property. However, this is not to say that *harmonically incomplete* languages are impossible, i.e. languages in which marked structures are admitted without less marked structures being admitted as well. Other factors may, indeed, come into play that give rise to *harmonically incomplete* languages. In this type of language a more marked structure surfaces because of the constraint system, but a less marked structure cannot surface due to some other constraint that interacts with the system proposed. In particular an *harmonically incomplete* language may result from the interaction of various dimensions of markedness. For example, we could easily conceive of a language in which there are only stops but not fricatives. If this language allows obstruent clusters, such clusters would only be of the type SS. The language would therefore lack the less marked FS and SF clusters, but allow the more marked SS and be *harmonically incomplete.* In Chapter 4, I will discuss the case of Takelma and show how the two dimensions of markedness relevant to obstruent clusters can conspire and yield a *harmonically incomplete* system.

### 2.5.4 Relative Well-formedness and Harmonic Bounding

In section 2.4.1, I have argued for the existence of harmonic orderings among the different types of clusters and established an evaluation metric for the computation of the relative harmony of each cluster with respect to each other. In section 2.5.2 I have shown how the ranking of these constraints will give rise to the patterns observed and how entailment considerations will account for the implicational relations observed. In this section I will focus on the relative well-formedness and ill-formedness of each cluster in the grammars predicted by the typology. The discussion will be in abstract terms and basically provide an optimality theoretical implementation of certain Morpheme Structure Constraints (MSC) (Kiparsky 1968), i.e. phonotactic constraints on sound sequences in each individual language. In Optimality Theory, MSC can be derived by the *Harmonic Bounding Argument*.

In OT, showing that a given structure is well-formed in a grammar is a matter of showing that an output parse containing such structure is optimal in the same grammar. The procedure to determine which output parse is optimal is based on *the Cancellation/Domination Lemma* (Prince and Smolensky 1993) discussed in Chapter 1 and repeated here for convenience.

(18) *Cancellation/Domination Lemma.* In order to show that one parse B is more harmonic than a competitor A which does not incur an identical set of marks, it suffices to show that every mark incurred by B is either canceled by an identical mark incurred by A, or dominated by a higher ranking mark incurred by A. That is, for

every constraint violated by the more harmonic form B, the losing competitor A either matches the violation exactly, or violates a constraint ranked higher.

To show that a structure is ill-formed in a grammar, instead, involves showing that such structure can never be an optimal output because of some other structure that is provably more harmonic and thus prevents it from surfacing. The general technique of analysis developed to account for ill-formedness is called *Harmonic Bounding***.** The technique is defined in Prince and Smolensky (1993) as follows:

(19) *Harmonic Bounding*. In order to show that a particular structure $\varphi$ does not appear in the outputs of a grammar, it suffices to show that any candidate structure A containing $\varphi$ is less harmonic than *one* competing candidate B not containing $\varphi$ (of the same input). (B provides a *harmonic (upper) bound* for A).

According to this method, in order to show that a structure $\varphi$ is ill-formed in a given grammar "it is sufficient to show that there is always a B-without-$\varphi$ that is better than any A-with-$\varphi$". For the Harmonic Bounding argument to be successful, B does not necessarily need to be optimal, it is sufficient to show that B is more harmonic than A. Whether B is optimal is a separate issue. Proving that B is more harmonic than A, it is therefore enough to show that no structure containing $\varphi$ will ever be optimal and that it will never occur in any output of the grammar.

Therefore, in terms of the typology proposed in this dissertation, to say that a cluster is ill-formed in a language is not to say that the cluster is not a possible input, but rather that no output of the grammar ever contains that cluster. A well-formed cluster in a grammar is one which is allowed to surface and corresponds to an optimal output candidate. An ill-formed cluster is, instead, one which, although in the input, is not allowed to surface by the constraint system and can never correspond to an optimal output candidate. To show that a cluster A in a given grammar does not surface, it is sufficient to show that there is one candidate B which is provably more harmonic than A. The cluster A is therefore bounded by the better candidate B (the *harmonic (upper) bound*). Candidate B, however, although more harmonic than A, may not necessarily be the optimal candidate. Throughout the analysis, I will show not only that for any impossible cluster in a given grammar, there is always a harmonic upper bound, but also that all the possible clusters in the same grammar represent harmonic bounds. Although irrelevant for the Harmonic Bounding Argument, among the harmonic bounds the FS candidate almost always turns out to be the most harmonic. Interestingly, FS is the unmarked obstruent cluster type.

Before illustrating the analysis in one of the typological grammars, a brief discussion of the inputs and the candidate set is necessary to understand what makes a cluster in a certain typological grammar either well-formed or ill-formed.

### 2.5.5 The Inputs and the Candidate Set

The four logical clustering possibilities, i.e. FS, SF, FF and SS are all considered to be possible inputs in any of the six grammars constructed for the six types of languages, because in OT inputs are universal and cannot be restricted. This principle is referred to as *Richness of the Base* (Prince and Smolensky 1993). The ill-formedness of certain clusters with respect to a given grammar is, therefore, obtained by showing that no input leads to an optimal output that contains such clusters, rather than rejecting them as inputs.

As for the candidate set, the only candidates which need to be considered for well-formedness considerations in the typological grammars are four structures which essentially contain the 4 possible clusters, FS, SF, FF and SS. The four candidates are produced by either changing or maintaining the value for the feature [continuant] on one or both segments of the input sequence as exemplified in the following table:

(20)

| Candidates | |
|---|---|
| Cand1 | both segments faithful to input values for [continuant] |
| Cand2 | only first segment unfaithful to input value for [continuant] |
| Cand3 | only second segment unfaithful to input value for [continuant] |
| Cand4 | both segments unfaithful to input values for [continuant] |

Obviously, the four candidates considered do not exhaust the range of possible candidates available to each input. Consider for example an input of the type FS.

There are at least two candidates which will have the structure SF for this input. One is obtained by changing the value for [continuant] on both segments, and the other one is the result of metathesis, i.e. correspondent segments maintain the same value for [continuant] but their linear order is reversed. These two candidates violate two different faithfulness constraints. The former candidate violates a constraint of the Ident(F) family, i.e. **Ident(cont)**, since both output segments have different input values for the feature [continuant]. The latter, on the contrary, violates **Linearity** (McCarthy and Prince 1995). This constraint basically says that any two elements of a string stand in an order relation which is necessarily preserved under linearity. Tableau (21) below shows the different violations incurred by the different candidates.

(21)

| /$F_iS_j$/ | Ident(cont) | Linearity |
|---|---|---|
| a. $S_iF_j$ | ** | |
| b. $S_jF_i$ | | * |

As shown in the tableau, candidate (a), which is obtained by changing the input value specification on both segments, incurs two violations of Ident(cont), one for each segment. Candidate (b), instead, does not incur any violation of Ident(cont), since the value of the correspondent segments is not changed as shown by the indexes, but their linear order is. Candidate (b) is a candidate that shows metathesis of the input cluster. In other words, this candidate is an example of a possible repair strategy and is not listed in (20). Since none of the languages that I surveyed shows this type of repair strategy[5], such a candidate as well as the relevant constraint will be omitted from tableaux.

Finally, there are also two other candidates which need not be considered for well/ill-formedness evaluations. The two candidates are one candidate in which one of the segments is deleted (deletion candidate), and one candidate whose obstruent sequence is broken up by the insertion of an epenthetic segment (epenthesis candidate). These two candidates exemplify possible "repair strategies", i.e. strategies a language would adopt to repair a sequence of consonants which is not allowed to surface in a given grammar. These candidates are not relevant candidates to consider for the question of relative well-formedness. This section attempts to account for how typological grammars construct their inventories of obstruent clusters and not how they would repair bad clusters resulting from morphological or phonological processes. In other words, this analysis is concerned with relative well-formedness and ill-formedness and not with phonological alternations. Determining which of the possible repairs strategies a language adopts to avoid ill-formed sequences is an independent question which I will discuss separately later in the chapter. In the next section, I will show how the Harmonic Bounding Argument works in imposing limitations on possible surface clusters in one of the typological grammars, i.e. *Type 1*

[5] A brief discussion of possible repair strategies is provided in Section 2.4.6. A typology of repair strategies is, however, outside the scope of this dissertation, because the dissertation focuses on well-formedness rather than repair strategies.

languages.

### 2.5.6 Harmonic Bounding and Well/ill-formedness in *Type 1* languages

*Type 1* languages are the languages which only allow FS as onset obstruent clusters. The analysis I will present in this section is about the relative well-/ill-formedness of each type of cluster in languages of this type. The analysis is not about how ill-formed clusters would be repaired but rather why the ill-formed clusters in this type of language can never make it to the surface. I will show that in *Type 1* languages no cluster other than FS can ever surface because FS represents the *harmonic upper bound*. Given any input, the candidate containing this cluster is always more harmonic than any other competing candidate, hence the only cluster allowed to surface. This result is obtained via interleaving the markedness constraints with the faithfulness constraint defined below:

(22) Ident(cont)[6]

Correspondent segments have the same value for the feature continuant.

This constraint belongs to the Ident(F) Constraint Family (McCarthy & Prince, 1995) and assures that input and output segments agree in the specification for the feature [continuant]. The general schema of the constraint is given below:

(23) Ident(F)

Let $\alpha$ be a segment in S1 and $\beta$ be any correspondent of $\alpha$ in S2.
If $\alpha$ is [$\gamma$F], then $\beta$ is [$\gamma$F]

[6] Remember that the point of this analysis is to evaluate relative well-formedness and not repair strategies. This is the main reason for using Ident(cont) rather than any other Faithfulness constraint.

The constraint ranking that determines well-formedness in a *Type 1* language is given in (24):

(24) OCP[+cont], OCP[-cont], *SO >> Ident(cont)

In this grammar, the three structural constraints are unranked with respect to each other but crucially dominate the faithfulness constraint Ident(cont), as shown in the tableaux demonstrating the ill-formedness of the non-occurring clusters. Obeying the requirement on the structure of obstruent clusters is therefore more important than faithfulness to the input in this grammar. In what follows I will first show how the constraint ranking established for *Type 1* languages will make FS surface while disallowing the remaining three cluster types and making them ill-formed in this type of languages.

Let us first start by considering an input of the type FS. The analysis is displayed in tableau (25):

(25)

| /FS/ | OCP[+cont] | OCP[-cont] | *SO | Ident(cont) |
|---|---|---|---|---|
| a. ☞ FS | | | | |
| b. FF | *! | | | * |
| c. SF | | | *! | ** |
| d. SS | | *(!) | *(!) | * |

The FS candidate is the only candidate which does not incur any violation of the structural constraints. It does not violate Ident(cont) either since it is faithful to the input. FF, SF and SS all fail because they all violate one of the high ranked structural constraints. Specifically, the FF candidate incurs a violation of OCP[+cont], and the SF candidate contains a sequence which violates *SO. Finally the SS candidate fails because of both OCP[-cont] and *SO, whose violations are equally fatal since they are unranked with respect to each other. The candidate containing the cluster FS is thus not only more harmonic than all the others, given the fact that it incurs no violations at all, but it is also optimal by virtue of being the most harmonic. This cluster is therefore well-formed with respect to this grammar and hence present in the languages of this type. As can be noticed, the input FS in this grammar does not provide any ranking argument for why Ident(cont) must be at the bottom of the hierarchy. An unranked Ident(cont) would, as a matter of fact, get the same result. It is only in the case of inputs which lead to ill-formed clusters that the ranking in (24) is crucial, as shown below.

With this constraint ranking where the structural constraints dominate faithfulness, given any input, none of the candidates which contain an input that violates the requirements imposed by the structural constraints will ever be optimal. The only candidate that does not violate any of the structural constraints, i.e. FS, will always be more harmonic than any of the competing candidates that instead violate one or more of the structural constraints. FS is therefore the *harmonic bound* that ensures that none of the other inputs will ever surface in this grammar. The Harmonic Bounding Argument is illustrated in the following tableaux.

(26)

| /FF/ | OCP[+cont] | OCP[-cont] | *SO | Ident(cont) |
|---|---|---|---|---|
| a. ☞ FS | | | | * |
| b. FF | *! | | | |
| c. SF | | | *! | * |
| d. SS | | *(!) | *(!) | ** |

In (26) the FF candidate is bound by the FS candidate. FS is more harmonic than FF since it incurs a violation of a lower ranked constraint. Ident(cont) must therefore be ranked at the bottom of the hierarchy for FS to be more harmonic than any of the other candidates. If Ident(cont) was unranked, the one mark assigned to FS would be as bad as any of the marks assigned to the competing candidates. FS could not be proven to be better than FF.

(27)

| /SF/ | OCP[+cont] | OCP[-cont] | *SO | Ident(cont) |
|---|---|---|---|---|
| a. ☞ FS | | | | ** |
| b. FF | *! | | | * |
| c. SF | | | *! | |
| d. SS | | *(!) | *(!) | * |

(28)

| /SS/ | OCP[+cont] | OCP[-cont] | *SO | Ident(cont) |
|---|---|---|---|---|
| a. ☞ FS | | | | * |
| b. FF | *! | | | ** |
| c. SF | | | *! | * |
| d. SS | | *(!) | *(!) | |

In (27) and (28), the candidate FS provides the harmonic bound which prevents SF and SS, respectively, from surfacing in this grammar. They are therefore, just like FF, ill-formed with respect to the constraint system of Type 1 languages.

### 2.5.7 Ill-formedness and Repair Strategies

The next question to be considered is what happens to ill-formed clusters that may arise in a particular language due to some phonological or morphological process. There are at least three ways in which individual languages can repair ill-formed clusters, although as we will see in the case of Nisqually, these are not the only possible repair strategies. A language can either delete one of the two segments in the cluster, or break up the offending sequence by inserting an epenthetic segment (usually a vowel), or change the ill-formed sequence into a well-formed one, i.e. by neutralization to the unmarked FS, as in the case of Modern Greek.

In (17), I used general Faithfulness to construct the typology of onset obstruent clusters. However, for each language type, there are at least three subtypes of languages based on the strategy that the language adopts to repair ill-formed clusters. Depending on the repair strategy, Faithfulness in (17) is replaced by one of the correspondence constraints, MAX-IO, DEP-IO (McCarthy and Prince 1995) or Ident(cont), which was discussed in 2.4.5. MAX-IO states that every segment of the input has a correspondent in the output. It prohibits phonological deletion. DEP-IO states that every segment of the output has a correspondent in the input. This constraint prohibits phonological epenthesis.

If DEP-IO is ranked in place of Faith in (17), and the other faithfulness constraints are also ranked higher than DEP-IO, we define a grammar where ill-formed clusters are repaired by inserting an epenthetic segment. If MAX-IO is ranked in place of Faith in (17), we define a grammar that repairs ill-formed clusters by deleting one of the segments. Finally, if Ident(cont) replaces Faith in (17), and the remaining two faithfulness constraints are higher ranked, we get a language in which marked clusters are neutralized to the unmarked FS. In what follows I will discuss each of the three possible repair strategies and show the relative ranking among the three different faithfulness constraints.

The ranking Ident(cont), MAX-IO >> DEP-IO defines a grammar where the offending clusters are repaired by epenthesis as shown in tableau (29). Consider an input SF, which, given the constraint system for *Type 1* languages, is not allowed to surface. DEP-IO being lower ranked with respect to the other faithfulness constraints will make this input surface as SəF (i.e. a sequence containing an epenthetic segment).

(29)

| /SF/ | Ident(cont) | MAX-IO | DEP-IO |
|---|---|---|---|
| a. FS | **! | | |
| b. F[7] | | *! | |
| c.☞ SəF | | | * |

The three candidates shown in tableau (29) include (a) a candidate whose structure contains the only possible cluster in the language (obtained by changing the feature specifications), a deletion (b), and an epenthesis candidate (c). The input cluster will surface as the epenthesis candidate since this candidate incurs a violation of a lower ranked constraint, and hence a lesser violation with respect to the other two candidates.

The ranking Ident(cont), DEP-IO >> MAX-IO defines instead a grammar which repairs ill-formed clusters by deleting one of the segments as shown in tableau (30):

(30)

| /SF/ | Ident(cont) | DEP-IO | MAX-IO |
|---|---|---|---|
| a. FS | **! | | |
| b. ☞ F | | | * |
| c. SəF | | *! | |

[7] For this discussion, it is irrelevant whether the first or second segment in the cluster is deleted.

Tableau (30) shows that given this constraint ranking, the deletion candidate will turn out to be optimal because it incurs a minimal violation with respect to the other candidates.

Finally the ranking MAX-IO, DEP-IO >> Ident(cont) defines a grammar that neither deletes nor epenthesizes, but rather turns an ill-formed cluster into the unmarked case for obstruent clusters, i.e. it adopts neutralization of marked structures into the unmarked one[8]. For example it turns an SS cluster into an FS, as exemplified in tableau (31):

(31)

| /SS/ | MAX-IO | DEP-IO | Ident(cont) |
|---|---|---|---|
| a. ☞ FS | | | ** |
| b. S | *! | | |
| c. SəS | | *! | |

To show how exploded Faith interacts with the hierarchy of constraints that I propose, consider for example a language which belongs to *Type 3* (i.e. only FS and SF are allowed) and that repairs ill-formed clusters via epenthesis. The constraint hierarchy for such a language would be the one given in (32):

(32) OCP[+cont], OCP[-cont], Ident(cont), MAX-IO >> DEP-IO >> *SO

[8] Note that this predicts that marked clusters can only turn into unmarked FS. In the analysis of Modern Greek in Chapter 3, I will show that a marked cluster, in particular a certain type of FF clusters can actually turn into SF rather than FS under special circumstances.

This hierarchy still assures that a cluster such as SF can surface in this language as shown in tableau (33):

(33)

| /SF/ | OCP[+cont] | OCP[-cont] | Ident(cont) | MAX-IO | DEP-IO | *SO |
|---|---|---|---|---|---|---|
| a.☞ SF | | | | | | * |
| b. FF | *! | | * | | | |
| c. FS | | | **! | | | |
| d. SS | | *! | * | | | * |
| e. F | | | | *! | | |
| f. SəF | | | | | *! | |

In tableau (33) the SF candidate will surface since it only incurs a violation of the lowest ranked constraint, *SO. At the same time, this ranking assures that a cluster of the form SS in this language does not surface, as the following tableau shows. However, given an input that cannot surface, the addition of MAX-IO and DEP-IO in the hierarchy, shows how this language will repair such an input. Consider for example an input SS as in the following tableau:

(34)

| /SS/ | OCP[+cont] | OCP[-cont] | Ident(cont) | MAX-IO | DEP-IO | *SO |
|---|---|---|---|---|---|---|
| a. SF | | | *! | | | * |
| b. FF | *! | | ** | | | |
| c. FS | | | *! | | | |
| d. SS | | *! | | | | * |
| e. S | | | | *! | | |
| f.☞ SəS | | | | | * | |

In tableau (34), the violation incurred by candidate (f) is minimal with respect to the violations of all other candidates. This candidate is optimal. It is therefore the candidate which will surface given an ill-formed input.

Compare tableau (34) with tableau (35) now. In tableau (35) a different relative ranking of the faithfulness sub-hierarchy is exemplified, i.e. Ident(cont), DEP-IO >> MAX-IO. This different relative ranking, interacting with the constraint system proposed, will specify a language which repairs an ill-formed cluster by deleting one of the segments rather than inserting an epenthetic segment.

(35)

| /SS/ | OCP[+cont] | OCP[-cont] | Ident(cont) | DEP-IO | MAX-IO | *SO |
|---|---|---|---|---|---|---|
| a. SF | | | *! | | | * |
| b. FF | *! | | ** | | | |
| c. FS | | | *! | | | |
| d. SS | | *! | | | | * |
| e. ☞ S | | | | | * | |
| f. SəS | | | | *! | | |

With DEP-IO dominating MAX-IO, inserting an epenthetic segment is a worse violation, in this grammar, than deleting one of the segments.

In the next section I discuss Greenberg's generalizations about obstruent clusters. I show how the onset generalizations identified in this dissertation improve upon Greenberg's generalizations.

## 2.6 Greenberg's Generalizations

Greenberg (1978) proposes four universals for obstruent clusters. Such universals express the preference for combinations of stops (S) and fricatives (F) as opposed to stop+stop or fricative+fricative in both initial and final systems. The preferences are expressed in terms of implicational universals of the form $\phi \Rightarrow \psi$, whereby the presence of a structure $\phi$ implies the presence of a structure $\psi$, but not vice versa. In initial position, Greenberg formulates the following two universals, respectively 7 and 9 in the original paper:

(36) "In initial systems the presence of at least one combination of stop+stop implies the presence of at least one combination of stop+fricative".

(37) "In initial systems the existence of at least one fricative+fricative combination implies the presence of at least one stop+fricative combination or at least one fricative+stop combination."

Using the notation introduced in the previous section, Greenberg's universals can be represented as follows:

(38) SS $\Rightarrow$ SF

(39) FF $\Rightarrow$ SF, FS

The implicational universal in (38) is based on Greenberg's observation that out of 25 languages with SS clusters, all of them also contained SF clusters and two, Huichol and Takelma, did not contain FS clusters. The generalization in (38) thus differs from the generalizations that I propose because, according to Greenberg, SF⇒FS does not hold. On the other hand, the implication in (39) is based on the fact that out of 33 languages containing FF clusters, only one language contained FF and SF but not FS (Karen) and two contained FF and FS but not SF (Icelandic and Kashmiri). No implications are discussed for FS and SF clusters. The generalization in (39) also differs from the generalizations proposed in (7) because, according to Greenberg, there is an implication between FF and SF that I did not find in my corpus.

The main problem with Greenberg's generalizations lies in the fact that he counts affricates as stop+fricative clusters. In other words, his generalizations cannot be an adequate representation of the principles of obstruent clusters due to the fact that single segments are confused with clusters. This gives rise to a faulty typology. As a matter of fact, many languages do have affricates in their inventory without necessarily admitting any complex onsets. This explains why in both Greenberg's universals (5) and (6), SF clusters are always present. Unlike Greenberg, in the universals I propose, the presence of any other obstruent cluster always implies the presence of FS clusters rather than SF. According to Greenberg, however, Huichol and Takelma contain SS and SF but not FS, and Karen contains FF and SF but not FS. These three languages would, as a matter of fact, violate the generalizations I propose because of the absence of FS clusters and the presence of more marked clusters.

None of these three languages, however, constitute a problem for the generalizations proposed in section 2.2. In particular, according to Greenberg, Huichol contains SF and SS clusters but not FS clusters. But according to the source (McIntosh, 1945), the language actually contains the alveolar and alveopalatal affricates /c, č/, which in Greenberg's analysis constitute obstruent clusters of the type SF, but in my analysis do not[9]. As for the SS clusters, all the clusters of this type occur in morphologically complex words whose initial segment is consistently /p/ or /c/, both of which have morphological content. Given that only SS clusters arising from affixation are found in the language, it can be assumed that obstruent clusters are indeed ill-formed in the language. Their exceptional occurrence can be explained by reference to a constraint that preserves morphological information, as in the case of Italian s+Fricative clusters to be discussed in Chapter 4.

As for Takelma, Greenberg claims there are only SS and SF clusters in the language, but no FS clusters. Again what Greenberg considers an SF cluster is in reality the palatal affricate /ts/, because according to Sapir (1922) the only common initial clusters in Takelma are [$t^h$p], [$t^h$k], [sp], [sk] , i.e. instances of SS and FS. Under the implication that I have proposed where SS ⇒ SF ⇒ FS, Takelma would represent a potential violation because it contains SS clusters without also allowing SF clusters. However, I will argue in Chapter 4 that Takelma is indeed a *harmonically incomplete* language which allows more marked structures at the expense of less marked ones. In Takelma the two

[9] The arguments for the monosegmental status of affricates are provided in Section 2.2.2.

dimensions that I will discuss in this dissertation, i.e. the manner and place dimensions, come into conflict and give rise to an *incomplete* system.

Finally, according to Greenberg, Karen contains FF but not FS clusters. Contrary to Greenberg's claim, none of the Karenic languages for which I have found data allow obstruent clusters. Karen languages are spoken in large areas of Burma and Thailand and only allow core clusters. Based on the data in Kato (1995), Karenic languages do not constitute violations of the generalizations I provide because they do simply not allow for obstruent clusters at all.

To conclude, I have shown, that although it is possible to find languages that violate the typology I propose, it does not necessarily mean that the typology is incorrect. Harmonically incomplete languages are not necessarily a challenge for the implicational relations holding among the four different types of obstruents. Harmonically incomplete systems exist due to independent factors, in each individual language, which interact with the rest of the grammar. In other words, the typology itself has the Property of Strong Harmonic Completeness, i.e. the constraint system gives rise only to harmonically complete languages. Harmonically incomplete languages may, however, result from the interaction of other markedness dimensions.