THE SPECIAL ROLE OF /S/ IN CLUSTER FORMATION: TYPOLOGICAL EVIDENCE FROM DIALECTAL VARIANTS OF GREEK

MARINA TZAKOSTA
University of Crete

Our paper provides a thorough and detailed investigation of the factors which influence the qualitative synthesis of two- and three-member /s/ clusters which emerge in several dialectal variants of Greek. The data are analyzed within the *Three Scales Model* which was initially proposed for two-member [obstruent + liquid] and [obstruent + obstruent] sequences as well as three-member clusters (Tzakosta, 2010, 2011, 2012, Tzakosta and Karra, 2011). The fact that /s/ clusters can be accounted for within the same model offers a new angle of seeing the role of /s/ in cluster formation. More specifically, we do not consider /s/ as an extrametrical element (Drachman, 1989; Giegerich, 1992) or part of a complex segment (Fudge, 1969; Selkirk 1982); rather /s/ is part of clusters which can be evaluated on a par with other cluster types and not on the basis of different theoretical approaches.

1 Introduction

Cluster formation is a popular topic of discussion in phonological theory because it is related to various aspects of the phonology of a language, such as the degree of cluster complexity, factors affecting stress assignment and the emergence of rhythmical patterns. Put differently, stress assignment and/ or the shape of the emergent rhythmical templates are in many languages determined by cluster complexity which, in turn, affects syllabic weight (Ewen and van der Hulst, 2001; Hayes, 1995; van der Hulst, 1984). Cluster well-formedness heavily lies on the Sonority Scale (hereafter SS) and Sonority Distance (hereafter SD) (Selkirk, 1984; Steriade, 1982).

The SS, which is depicted in figure 1 below, determines cluster well-formedness in a progressive and rightward manner. More specifically, given that phonemes rise in sonority from left to right, stops are the least sonorous whereas vowels are the most sonorous segments. Sonority was first introduced by Sievers (1901) and further developed by Jespersen (1904). Sonority is considered to be a universal principle dependent on phonological grounds. Moreover,

there are acoustic studies which further support its universal cross-linguistic character (cf. Jany et al, 2007).

Figure 1. The classical sonority scale

Sonority is a gradient notion in the sense that it is comparative. The more sonorous a segment is the more chances it has to occupy syllabic nuclei positions. Put differently, the least sonorous a segment is the more probable it is to be part of a syllabic onset or a syllabic coda. Therefore, a syllable is a contour schema rising in sonority towards the nucleus and falling in sonority towards the coda. To give an example, rightward satisfaction of the scale implies that stops may cluster with any consonant type to their right on the scale and result in well-formed clusters. On the other hand, fricatives can cluster with all consonant types except for stops which are located to their left (for detailed discussion on the SS see Tzakosta, 2010, 2011, 2012).

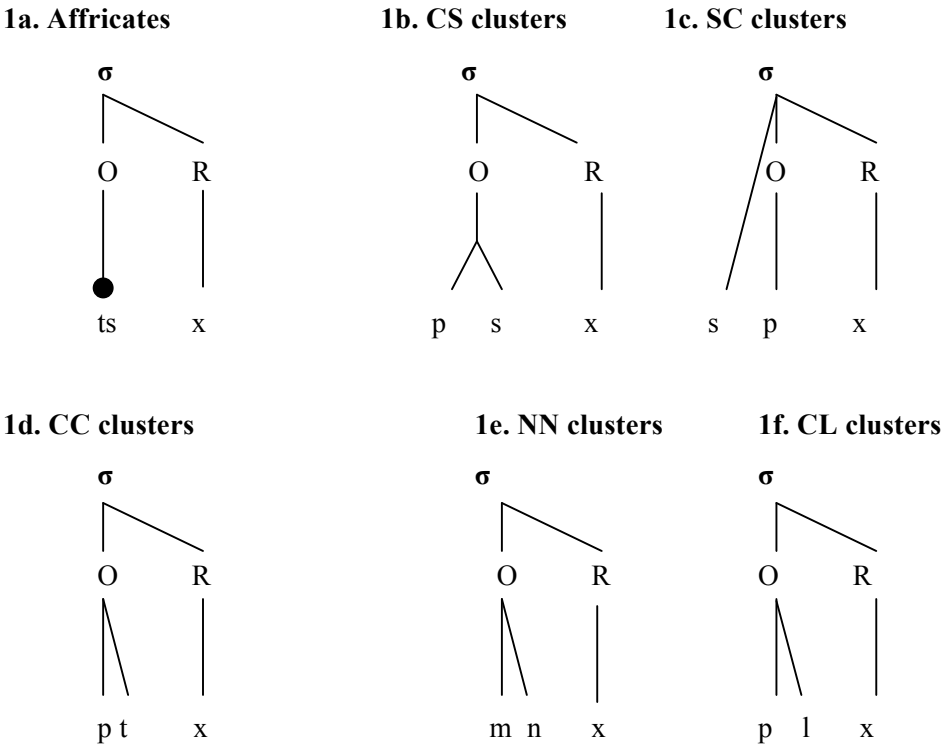
SD, on the other hand, is qualitative in nature because it determines the degree of cluster well formedness (cf. Clements, 1988, 1990, 1992). More specifically, cluster members marked by the biggest possible sonority-rising distance between them make up the best-formed clusters. Numbers on the SS signal the distance among cluster members. Consequently, a SF cluster like /px/ marked with SD (1) is less well-formed compared to SL[1] sequences like /pl/ marked with SD (4), though both are well-formed clusters (see also Tzakosta, 2011, 2012). Gradience in cluster formation is one of the cores of the present study which will be discussed in detail.

Claims like the ones discussed above allow us to make certain predictions regarding cluster perception and production. In other words, if it is true that the SS and SD govern cluster perfection, then, a perfect cluster would be perceptually more salient than a simply acceptable cluster; as a result, the former would have more chances to remain intact in its surface/ phonetic realization. In other words, we would expect that the SS and SD drive 'clarity' of perception which, in turn, facilitates production. Consequently, CL rather than CC or /s/ clusters are expected to emerge more frequently not only cross-linguistically but also in various aspects of a language. These assumptions are reinforced by the fact that multiple repair strategies, such as epenthesis, deletion or fusion, apply in clusters with small SD, like SF or FN, whereas clusters with big SD are characterized by vowel anaptyxis.

In addition, Tzakosta (2009) and Tzakosta and Vis (2009a, 2009b, 2009c) have proposed a structural complexity account of consonant clusters. Within their proposal, clusters are signaled by different degrees of cluster complexity and coherence. Based on diachronic evidence as well as developmental data, Tzakosta (2009) and Tzakosta and Vis (2009a, 2009b, 2009c) suggest different structural representations for different cluster types. According to these representations, which are depicted in schemas (1a-1f) below, affricates are considered to be monopositional segments, while other /s/ clusters have different representations depending on whether /s/ is the first or second member of the cluster. Therefore, when /s/ is the first member of the cluster, /s/ is shown to be extrametrical (1c), whereas /s/ is part of a complex segment when it is the second member of a consonantal sequence (see (1b). This implies that CS clusters are more coherent compared to SC ones. In the same proposal CC, CN and CL sequences make up 'true' clusters.

[1] S stands for stops, F for fricatives, L for liquids, N for Nasals, C for obstruents, .i.e. stops and fricatives.

This proposal has important implications for language acquisition. More specifically, the more coherent a cluster is the more salient it is perceptually. Consequently, the less prone a coherent cluster is to repair strategies, most common of which is reduction. However, this theoretical approach does not explain, first, why /s/ is commonly found in Greek clusters and, second, why recent developmental data illustrate that /s/ clusters are the first to be produced in Greek child speech (Tzakosta, 2013).



Schemas 1a-1f. Structural representations of consonant clusters

The main claim of the present approach is that the SS, SD and structural complexity account are not explanatorily sufficient theoretical tools to account for the systematic emergence of /s/ clusters in Greek varieties given that /s/ clusters are non-theory-predicted clusters. Instead, in the present paper we adopt the *Three-Scales Model* which was initially proposed by Tzakosta (2010, 2011, 2012) and Tzakosta and Karra (2011), again for dialecta data. More specifically, the investigation of /s/ clusters further support the idea that clusters may be *perfect*, *acceptable* or *non-acceptable* (cf. Tzakosta, 2010, 2011, 2012, Tzakosta and Karra, 2011). Perfect, acceptable and non-acceptable cluster formation depends on and is evaluated in parallel by means of the satisfaction of three distinct scales, those of place of articulation, manner of articulation and voicing which must be satisfied in a rightward manner. Cluster perfection and acceptability are gradient notions due to SD. For example, /pl/ and /fl/ are both perfect clusters, but /pl/ is better-formed than /fl/ because the SD is bigger for /pl/ (4) than for /fl/ (3). In sum, we argue that cluster formation is driven by the parallel satisfaction of multiple scales of manner, place and voicing in combination to Distance (hereafter D). A crucial advantage for the establishment of the Three Scales Model is that scales contribute, except for well-formed cluster formation, to the establishment of principles which drive syllabification.

Although there is solid argumentation regarding the universal and parametric factors that determine the formation of consonant clusters at the level of the SS and SD, little has been said regarding the internal coherence of consonant clusters and additional factors which drive cluster acceptability and cluster perfection in different languages or different aspects of the same language. In this study, we investigate this issue focusing on Greek dialectal data, and, more specifically, /s/ clusters. The remainder of the paper is organized as follows; Section 2 discusses the data sources, the research limitations and the working hypotheses of the study, while section 3 presents the factors determining /s/ cluster formation in light of the three scales model. Finally, section 4 concludes the paper.

2 Data sources, limitations and working hypotheses

In the present paper we draw on indexed dialectal data from the major dialectal zones of northern and southern Greece (Epirus, Meleniko, Lesvos, Pontos, Thassos, Corfu, Attica, Thessalia, Kozani, Trikala, Samothraki, Thessaloniki, Koutsovlahika - Cyprus, Crete, Dodekanese, Ikaria)in order to assess the above claims. The focus is on two- and three-member consonant clusters in which /s/ emerges in all possible cluster positions. We do not consider CCJ clusters since we see [j] as product of vowel raising (cf. also Tzakosta 2011). Moreover, we will not discuss clusters which emerge both in the dialects and the norm because focus is placed on special and 'deviant' cluster formations

The theoretical claims discussed in the following section develop the ideas promoted in Tzakosta (2010, 2011, 2012) and Tzakosta and Karra (2011) regarding the establishment of three distinct scales of place of articulation (hereafter PoA), manner of articulation (hereafter MoA), and voicing (hereafter V) being involved in the evaluation of cluster well-formedness.

3 /s/ clusters formation and cluster well-formedness in light of the Three-Scales Model

Before we elaborate on the Three-scales Model we find it essential to roughly discuss the fundamental properties of the phonotactic constraints of Greek. Greek is rather free regarding the combination of consonants that may cluster together. However, it is conservative when it comes to the number of consonants a cluster may consist of. More specifically, Greek clusters may consist of at most three consonants (cf. Tzakosta, 2011, 2012 for detailed discussion). In three-member clusters the initial cluster member may often be /s/ (1i). Four member clusters occur in cases of morphological blending as shown in (1f-g) or loanwords (1e). /s/ may combine with any kind of consonant segments , i.e. obstruents, nasals and liquids emerging either in initial or second position. This is shown in (1a, 1b) and (1c, 1d), respectively. In the discussion that follows, we will observe that Greek dialectal variants are even freer in the formation of /s/ clusters.

(1a) [stóxos] 'target'[2]
(1b) [ésxos] 'shame'
(1c) [éfsima] 'distinctions of merit'
(1d) [pséma] 'lie'
(1e) [afstría] 'Austria'
(1f) [éfstoxos] 'accurate'
(1g) [efsplaxnía] 'charity'
(1i)[stratós] 'army'

Given the discussion in section 1 above, data such as those in (1) violate the SS although they are perfectly acceptable in Greek. In other words, the SS fails to provide a satisfactory account of the certain categories emerging in Standard Greek. Following Tzakosta (2012), we assume that the problem arises because the SS sees segments as inseparable wholes and provides information with respect to the principles which govern cluster formation and not why certain clusters are better- or worse-formed than others. According to the three scales model, the SS should be one of the dimensions of evaluating consonant clusters' well-formedness. More specifically, all cluster types, among which /s/ clusters, should be evaluated separately with respect to MoA, PoA and V in order to assess subtle cluster differentiations. Given the cluster categorization suggested above, we suggest that perfect, acceptable and non-acceptable cluster formation depends on the degree of satisfaction of the scales of manner, place and voicing which are illustrated in figures 2, 3 and 4, respectively. Like the classical SS, all scales need to be satisfied in a rightward manner. However, not all clusters are perfect to the same extent, since, as already mentioned, cluster perfection is gradient; the bigger the D among cluster members on all scales the better-formed the cluster.

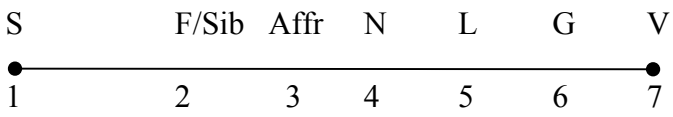


Figure 2. The MoA scale

The data in (2) will be discussed with respect to the three scales of MoA, PoA and V. It will be shown that /s/ clusters – like all other cluster types (cf. Tzakosta, 2010, 2011, 2012, Tzakosta and Karra, 2011) – violate at least one of the scales and (vacuously) satisfy another. Vacuous scale satisfaction implies that the SD is 0. In other words, all cluster members land on the same point on a scale, for example, they are all fricatives, or stops, or coronals, or voiced. Therefore, (2a) satisfies the MoA scale since the first member of the cluster is a stop and the second is a fricative. In other words, the scale is satisfied in a rightward manner. The same holds for (2b) and (2d). (2c), on the other hand, violates the scale since the selection of the cluster members is not rightward, i.e. the first member is a fricative and the second is a stop. Finally, (2e) vacuously satisfies the scale since both members of the /s/ clusters land on the same point of the MoA scale, namely they are both fricatives.

[2] Only surface forms of Standard Greek are provided. We assume that underlying and surface forms coincide in the standard language.

(2a) [**ks**ígla] ‘part of the loom-FEM.NOM.SG.’[3]
(2b) [bru**sn**ós] ‘front-ADJ.MASC.NOM.SG.’
(2c) [li**šc**áris] ‘meat lover-MASC.NOM.SG.’
(2d) [**ks**iftó] ‘date-PRES.IND.1SG.’
(2e) [fi**sf**isés] ‘capricious-MASC.NOM.SG.’ (Meleniko, Andriotes, 1989)

Table 1 provides examples of perfect, acceptable and non-acceptable /s/ clusters with respect to MoA.

Types	**Perfect**	**Accept**	**Non-accept**
Stop + L	√		
Fric + L	√		
Fric + N	√ /sn/		
Stop + Stop		√	
Fric + Fric		√ /sf/	
Stop + Fric	√		
Fric + Stop			√ /ks/
Stop + Affric	√		
Affric + Stop			√
Fric + Affric	√		
Affric + Fric			√

Table 1. Gradience in cluster formation with respect to MoA

On the other hand, the place scale depicted in fig. 4 is equivalent to the fixed place hierarchy proposed by Prince and Smolensky (1993). According to this hierarchy, velars are more marked compared to labials and labials are more marked compared to coronals. Interpreting the fixed place hierarchy into the place scale proposed here means that a velar or a labial needs to be the leftmost member of a cluster if a coronal is the rightmost one. Accordingly, in order to form a perfect cluster, if the second member of a cluster is a labial, the first member needs to be a velar.

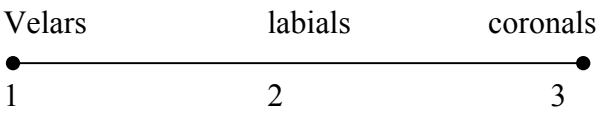


Figure 3. The PoA scale

Going back to the data in (2), we observe that (2a) and (2d) satisfy the PoA scale since the first member of the cluster is a velar and the second a coronal. On the contrary, (2c) and (2e) violate the scale, because cluster members are not selected in a rightward manner, namely the first member of both clusters is a coronal while the second is a velar for (2c) and a labial for (2e). (2b) vacuously satisfies the PoA scale, i.e. both cluster members are coronals.
Table 2 provides examples of perfect, acceptable and non-acceptable /s/ clusters with respect to PoA.

[3] In cases in which it is not clear the shape of the underlying form, only the surface forms are provided in square brackets.

Types	**Perfect**	**Accept**	**Non-accept**
Lab + Lab		√	
Lab + Cor	√		√ /sf/
Lab + Vel			√
Cor + Cor		√ /sn/	
Cor + Lab			√
Cor + Vel			√
Vel + Vel		√	
Vel + Cor	√ /ks/		
Vel + Lab	√		

Table 2. Gradience in cluster formation with respect to PoA

Finally, the voicing scale in fig. 4 requires that segments may be either [-voiced] or [+voiced]. According to this scale, a perfect cluster is a cluster whose first member is [-voiced] and the second is [+voiced]. The converse voicing order is responsible for the formation of non-acceptable clusters. Consonants sharing the same voicing characteristics, i.e. if they are both voiceless or voiced, form acceptable clusters.

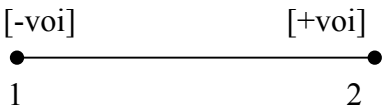


Figure 4. The V scale

The data in (2) support the rightward satisfaction of the voicing scale, which implies that the first member of the cluster is voiceless while the second is voiced. We assume that in languages like Greek in which both voiced and voiceless segments are allowed in all word positions – which means that nor voicing or devoicing is preferred – assimilation of both voicing and devoicing are allowed. Of the data in (2), (2a) and (2c)-(2e) vacuously satisfy the V scale – both cluster members are [-voi]- while (2b) clearly satisfies it.

The data in (3) display exceptional cases in which the V scale is not satisfied, still non-acceptable sequences with respect to V emerge. These are word final sequences, like those in (3a) and (3b) in which word formation processes are activated (verb conjugation). Finally, (3c) is an example V violation which signals heterosyllabicity.[4]

(3a) /le.**jis**/ → [le**γ+s**#] ‘say-2nd.PRES.IND.SG.’
(3b) /ba.ka.**lis**/ → [baka**l+s**#] ‘grocer-MASC.NOM.SG.’ (Drimos, Κατσάνης 1983)
(3c) [ku.lu.kú**r.zm**a] ‘cutting sb’s hair from behind-NEUT.NOM.SG.’
(Kozani, Margariti-Roga 1989)

Table 3 provides examples of perfect, acceptable and non-acceptable /s/ clusters with respect to V.

[4] Such exceptional cases would perfectly be accounted for through Government Phonology (Charett 1991, Harris 1994, Kaye 1990).

Types	Perfect	Accept	Non-accept
[-voi] + [-voi]		√	
[-voi] + [+voi]	√ /sn/		
[+voi] + [+voi]		√	
[+voi] + [-voi]			√ /γs/[5]

Table 3. Gradience in cluster formation with respect to V

The data in (4), (5) and (6)[6] provide representative examples of possible three-member /s/ clusters occurring in dialectal variants in all word positions, in initial and medial syllabic onsets, in stressed and unstressed syllables. We have already mentioned that for a cluster to be perfect it needs to satisfy all scales and SSD. Given the conditions of well-formedness posed by the MoA, PoA and V scales, it is easy to understand that it becomes quite complex to evaluate well-formdness of three-member clusters. In three-member clusters, all cluster members are cross-evaluated with respect to each other, i.e. the first with second, the second with the third, the first with the third; it then becomes interesting to observe that perfect and non-acceptable clusters are not attested in the set of data under investigation. Especially when /s/ emerges in cluster initial position and another cluster member is a stop - with respect to MoA- or a velar/ labial – with respect to PoA – renders these three-member clusters acceptable. As already mentioned, acceptable clusters may violate one of the scales of place and manner and (vacuously) satisfy the other, or violate both scales of place and manner. It is crucial, though, that the V scale needs to be (at least vacuously) satisfied in acceptable clusters. It is indeed the case that all clusters satisfy or vacuously satisfy the V scale. Some representative examples are illustrated in ((3a), (3b), (3d), (3e), (4a), (4c)-(4e)) and ((3c), (4b), (4f)-(4h)), respectively.

(4a) /**st**i.**m**ó.ni/ → [**stm**ó.ni] ‘warp-NEUT.NOM.SG.
(Kozani, Margariti-Roga, 1989)

(4b) /kló.**st**is/ → [gó.**str**is] ‘spinner-MASC.NOM.SG.’
(Drimos, Κατσάνης, 1981, 1983)

(4c) /**sp**i.**t**ó.γa.mbros/ → [**spt**ó.γa.mbrus]
‘groom living in the bride’s home-MASC.NOM.SG.’
(Meleniko, Andriotes, 1989)

(4d) [**str**ifnáδi] ‘cantacerous person-MASC.NOM.SG.’

(4e) [**skl**ibuniáris] ‘cackectic person-MASC.NOM.SG.’
(Meleniko, Andriotes, 1989)

(5a) /**ps**i.**l**ós/ → [**pšl**ós] ‘tall-DJ.MASC.NOM.SG.’

(5b) /**ps**i.**x**í/ → [**pšÇ**í] ‘soul-FEM.NOM.SG.’

(5c) /**ks**i.**n**ós/ → [**kšn**ós] ‘acerbic-ADJ.MASC.NOM.SG.’

(5d) /pní.**ks**i.**m**o/ → [pŊí.**kšm**u] ‘chocking/ straggling-NEUT.NOM.SG.’
(Meleniko, Andriotes, 1989)

(5e) [za.nó.**ksl**u] ‘long stick-NEUT.NOM.SG.’

[5] Heterosyllabic sequences.

[6] In the set of data in (3), /s/ emerges in cluster-initial position, in (4), .s. emerges in cluster-medial position, while in (5), /s/ emerges in cluster-final position.

(5f) /**p**i.**st**é.vo/ → [**pšč**é.vu] ‘believe-PRES.IND.1SG.’
(5g) /**p**i.**st**ó.li/ → [**pst**ól] ‘gun-NEUT.NOM.SG’
(5h) /**xr**i.**st**ós/ → [**kst**ós] ‘Christ-MASC.NOM.SG.’
(Siatista, Παπαδημητρίου & Μαργαρίτη-Ρόγκα, 1983)

(6) /trá.**v**i.**ks**a/ → [trá.**fks**a] ‘pull-PAST.IND.1SG.’
(Siatista, Παπαδημητρίου & Μαργαρίτη-Ρόγκα 1983)

Table 4 summarizes the (dis)satisfaction of the MoA, PoA and V scales with respect to three-member clusters. SD is not considered since perfect clusters do not emerge. Multiple cell asterisks indicate the number of cross-violations of each scale. Depending on the number of incurred violations, it becomes obvious that some three-member clusters mostly fall within the category of acceptable clusers.

Clusters/ scales	**PoA**	**MoA**	**V**
/ksl/	**	√	√
/stm/	√	*	√
/str/	√	*	√
/spt/	*	**	√
/pšl/	**	√	√
/kšn/	**	√	√
/kšm/	**	√	√
/pšč/	*	√	√
/fks/	***	*	√

Table 4. Gradience in three-member cluster formation

Given the above discussion, according to the Three-Scales Model of cluster well-formedness clusters are perfect if they satisfy all scales at least with minimal D (1). Clusters are acceptable under certain conditions; first, if they vacuously satisfy all scales, second, if they violate one of the scales of manner or place and (vacuously) satisfy the other or, third, if they violate both MoA and PoA scales but at least vacuously satisfy the V scale. Non-acceptable clusters emerge as long as all scales are violated and/ or the V scale is violated even if the manner and place scale are at least vacuously satisfied.

It is important to note that /s/ clusters, especially two-member clusters, emerge in all word positions, i.e. initial ((7a), (7b)) or medial ((7c), (7d)) in either stressed or unstressed syllables.

(7a) **ks**ígla ‘part of the loom-FEM.NOM.SG.’
(7b) **ks**iftó ‘date-PRES.IND.1SG.’
(7c) bru**sn**ós ‘front-ADJ.MASC.NOM.SG.’
(7d) fi**sf**isés ‘capricious-MASC.NOM.SG.’ (Meleniko, Andriotes, 1989)

4 Conclusion

In this study, we proposed a typology of /s/ clusters based on their production patterns in dialectal varieties of Greek. Our proposal is that the SS and SD as well as other relevant approaches are not sufficient means to account for the acceptability and/ or perfection of consonant clusters. In the current proposal we suggest that clusters are categorized as perfect, acceptable and non-acceptable on the basis of the three distinct scales of manner, place and voicing which are involved in cluster formation.

The scales of manner, place and voicing are satisfied in a rightward manner. Clusters are perfect under one major condition: to minimally satisfy all scales. On the other hand, clusters are acceptable under three conditions: first, if they vacuously satisfy all scales, second, if they violate one of the scales of manner or place and (vacuously) satisfy the other but always (and at least vacuously) satisfy the voicing scale, and, third, if the voicing scale is at least vacuously satisfied but both scales of manner and place are violated. Vacuous satisfaction is characteristic of acceptable cluster but never of perfect clusters. Non-acceptable clusters emerge as long as, first, all scales are violated, and, second, the voicing scale is violated even if the manner and place scales are at least vacuously satisfied.

Most /s/ clusters are acceptable and emerge massively in various language aspects because they are flexible and predicted by the typology. Greek dialects – especially those of the northern dialectal zone-are less conservative regarding cluster synthesis given that clusters may appear even in coda position due to the application of phonological rules according to which high vowel loss and raising applies in unstressed syllables (Newton, 1972: 196 ff.).

There are two innovative features of the present approach; on the one hand, apart from the fact that the Three-Scales Model is more flexible regarding the definition of well-formed clusters, it can account for the formation of all cluster types. More specifically, our proposal solves the problem of the status of /s/ in consonant clusters since we do not need to characterize /s/ as extrametrical (Drachman, 1989; Giegerich, 1992) when it emerges in cluster-initial position or as part of a complex segment (Fudg,e 1969; Selkirk, 1982) when it emerges in cluster-final position. Rather, we evaluate all cluster types on a par. On the other hand, the violation of all scales is an indication that non-well-formed sequences are heterosyllabic. In other words, the Three-Scales Model further gives new insights regarding the phonotactic constraints of Greek.

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