Crossing Phonetics-Phonology Lines

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Edited by

Eugeniusz Cyran and Jolanta Szpyra-Kozłowska

CAMBRIDGE SCHOLARS
PUBLISHING

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This book first published 2014

Cambridge Scholars Publishing

12 Back Chapman Street, Newcastle upon Tyne, NE6 2XX, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-4438-5992-3, ISBN (13): 978-1-4438-5992-9

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FOREWORD

Ever since a distinguished Polish linguist Jan Baudouin de Courtenay in the 1880s and fifty years later Nikolay Trubetzkoy divided the study of speech sounds into two separate, yet closely connected disciplines of phonetics and phonology,[1] in agreement with the Saussurean dichotomy of *langue* and *parole*, the nature of the relations between them has intrigued generations of linguists who have approached this issue in a variety of ways, two of which have been particularly influential.

According to the followers of the Courtenay/Trubetzkoy tradition, phonology and phonetics are two completely different aspects of sound systems which require divergent methods of analysis; the former deals with "sounds in the mind" and involves various abstract theory-bound units (e.g., phonemes, underlying segments, distinctive features, skeletal positions, syllabic constituents, prosodic units, melodic elements, etc.) as well as mechanisms governing their behaviour (e.g., rules, derivations, constraints, governing and licensing relations, etc.), while the latter is concerned with "sounds in the body", i.e., physically measurable properties of sound articulation, acoustics and perception. In such "separational" approaches, typically represented earlier by Glossematics and more recently by abstract generative analyses of the SPE type and the majority of Government Phonology studies, phonology is claimed to be autonomous from phonetics and insensitive to phonetic detail.

Other scholars maintain, however, that the division of the study of sound structure into phonetics and phonology is not only artificial and unnecessary, but even harmful as there is no clear-cut boundary between the two areas and, on the one hand, a number of problems traditionally viewed as phonological in nature cannot be adequately addressed without a direct access to low phonetic data and, on the other hand, many phonetic issues, such as gradience and variation (articulatory and perceptual), appear to require phonological processing. This stance is taken by such linguists as, most notably, John Ohala, the majority of versions of Optimality Theory, in which the same constraints are postulated for phonological and

[1] As a matter of fact, Baudouin de Courtenay used a different terminology and made a distinction between anthropophonics, i.e., the study of purely physical aspects of language, which corresponds to phonetics, and psychophonetics, i.e., the study of the mental aspects of the sound system, that is phonology.

phonetic phenomena, as well as in Laboratory Phonology studies devoted to experimental testing of various phonological claims and assumptions. Such approaches, which can be dubbed "integrational", appear to dominate in current linguistic research.

Needless to say, no analytic model is monolithic and within each of them a variety of views can be found which cannot be easily subsumed under the "separation" versus "integration" philosophy and which try to find some middle ground between these two extremes. For instance, proponents of modular phonology maintain that it is sensitive to some, but not all, aspects of phonetics; the latter are needed to define distinctive features (or elements in GP), to explain some phonological patterns and implement phonological representations.

The present volume is a significant and up-to-date contribution to this debate, provided by researchers from different countries and representing diversified theoretical positions with respect to the phonetics-phonology relations. It is a collection of papers whose authors analyze selected phenomena on the borderline of phonetics and phonology in various languages, such as English, Italian, Welsh, Polish, German, Southern Saami, Saraiki and many others in order to shed more light on the nature of the sound structure of human language. It is a juxtaposition of different theoretical approaches, such as Optimality Theory, Government Phonology, Laboratory Phonology, etc., coupled with their application to the analysis of specific language data that makes this book particularly valuable and different from other current publications.

Part I comprises several analytic studies carried out within well-established models of Government Phonology (GP) (Section One) and Optimality Theory (OT) (Section Two), which represent the "separational" and "integrational" perspectives on the phonetics-phonology interrelations respectively. Section Three includes chapters with the authors' theoretical stance which cannot be subsumed under the previous two headings.

Part II examines connections between phonetics and phonology through a series of experimental studies, the majority of which are written in the spirit of Laboratory Phonology. Their authors express a conviction, either explicitly or implicitly, that many phonological claims can be verified empirically as phonetics and phonology are two inseparable sides of one coin.

Section One of **Part I** contains six chapters, written within the GP model and its Element Theory in particular, whose authors deal with a number of phonetic and phonological phenomena that have so far escaped straightforward explanation. **Antonio Baroni** examines the unusual phonological behaviour of /s/ in Northern Italian dialects, in which this frica-

tive appears to be patterning with both obstruents and liquids. A related issue is undertaken by **Grzegorz Michalski,** who discusses formal restrictions on the occurrence of /st/ and /str/ initial clusters in English monomorphemic words from the perspective of markedness and overgeneration. **Eugeniusz Cyran** presents a simple model of phonology-phonetics interaction, which is an extension of the Element Theory. He claims that obstruentization is not a possible phonological process that could be included in synchronic grammars. **Guillaume Enguehard** deals with word stress in Southern Saami and proposes to view it as a realization of a structural unit which is part of phonological representation. **Krzysztof Jaskuła** discusses the propensity of Polish labial consonants for elision in unguarded speech and argues that it should be explained by reference to the internal structure of the consonants in question. Finally, **Artur Kijak** looks at the internal structure of English velar consonants and the relationship between velarity and labiality suggesting a melodic representation of these segments that accounts for their behaviour.

Section Two includes five chapters based on the premises of OT. Two of them, by **Haike Jacobs**, and by **Nasir Abbas Syed** and **Sultan Melfi Aldaihani** address the complex and controversial issue of loanword adaptation. The former proposes a novel OT-based model of perception and production which deals successfully with the phenomenon of perceptual illusion. The latter focuses on mechanisms involved in the substitution of complex emphatic consonants in Arabic loanwords borrowed by Saraiki. **Antonio Baroni and Marko Simonović** examine a number of reduction phenomena that occur in casual speech in various languages in order to find out how the immense variability of phonetic input allows for a construction of an abstract underlying representation. **Iwona Czyżak** attempts to provide a uniform phonological analysis of the fast-spreading phenomenon of glottalisation in English, which displays a high degree of intra- and interspeaker variability. **Bartłomiej Czaplicki** analyses expressive palatalization found in Polish diminutives and supports lexicon-based approaches to phonology which assume that the unit of storage is a word, not a morpheme.

Three chapters in **Section Three** present different approaches to the sound structure than those proposed by OT and GP. **Anita Buczek-Zawiła** studies initial consonant mutations in Welsh in a broader context of Cognitive Grammar which maintains non-modularity of cognitive representations and focuses on usage as the primary aspect in acquisition and structure development. **Tobias Scheer** assumes a more global perspective of all interfaces in modular architecture of grammar responding to the same logic and maintains that phonology and phonetics are related through the

mechanism of phonetic interpretation. **Geoffrey Schwartz** and **Grzegorz Aperliński** consider the problem of consonant perception in terms of external and internal cues, and propose parameters to describe the relative weight of CV transitions across languages by incorporating them in the phonological representation of the consonants.

Part II offers six chapters devoted to experimental studies in the spirit of Laboratory Phonology, examining various aspects of phonology-phonetics interdependencies. **Grzegorz Krynicki** demonstrates that articulatory correlates of the phonemic distinctive features can be induced statistically from dimensionality-reduced EPGL data and argues that they are not binary, but work in bundles and may conflict with each other. **Katharina Nimz** sets out to verify empirically the claim that German vowel length poses a special problem for Turkish learners of German and shows that experimental results are better predicted by a phonetic contrastive analysis than a phonological one. **Marek Radomski** examines on-line adaptation of Polish CC clusters by native speakers of English and factors behind the choice of an employed repair strategy (consonant elision, vowel epenthesis and cluster modification). **Arkadiusz Rojczyk** and **Andrzej Porzuczek** look at the acoustic properties of nasal geminates in Polish both in terms of a double/single articulation pattern as well as acoustic properties of nasal sequences and neighbouring vowels. The authors maintain that the proportion of geminates with double articulation is relatively low, which contrasts with the observed tendency in contemporary Polish to increase double articulation of geminates. **Radosław Święciński** provides acoustic evidence for the presence of the palatal glide /j/ after palatalized consonants in Polish and argues that this segment must be found at the phonological level, contrary to claims made by other researchers. **Sławomir Zdziebko** and **Mateusz Urban** consider phonetic and phonological aspects of the phenomenon of /ɬ/ vocalisation in Ayrshire Scottish English and, using the GP Element Theory, propose a phonological representation of this consonant which accounts for its properties.

The book is addressed to linguists and students of linguistics, particularly those interested in phonetics, phonology and the connections between them.

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ACKNOWLEDGMENTS

We would like to express our deepest gratitude to the two reviewers **Linda Shockey** from Reading University and **Péter Szigetvári** from Eötvös Loránd University, Budapest whose meticulous comments have largely improved the quality of this volume.

PART I

ANALYTIC APPROACHES TO THE PHONETICS-PHONOLOGY RELATIONS

SECTION ONE

GOVERNMENT PHONOLOGY-BASED STUDIES

ELEMENT THEORY AND THE MAGIC[1] OF /s/

ANTONIO BARONI

1. Introduction

In a great number of languages, the consonant /s/ displays a peculiar behaviour compared to other fricatives such as /f, x/. For example, /s/ is more likely than any other consonants to occur in extrasyllabic position, both word-initially and word-finally.

In this paper I will limit my analysis to a variety of Italian spoken in the northern part of the country (broadly speaking, the Italian spoken in Aosta Valley, Piedmont, Liguria, Lombardy, Trentino Alto Adige, Friuli Venezia Giulia, Veneto and Emilia Romagna[2]). In section 2 I will show why NI is different from other varieties of Italian with respect to assimilatory processes. In section 3 the behaviour of /s/ will be analyzed, showing that this fricative appears to be patterning with both obstruents and liquids. Subsequently, a traditional phonological explanation and a phonetically based one are presented in order to account for the tendency of /s/ to violate the Sonority Sequencing Principle. In sections 5 and 6 the CVCV framework and Element Theory are introduced, albeit in a slightly modified version where the acoustic primes considered are reduced to four: **C**, **V**, **I** and **U**. In the remainder of this paper, a new way to account for the intervocalic and pre-consonantal voicing of /s/ is proposed, as well as an explanation for the floating status of word-initial /s/ in consonant clusters. Basically, it is argued that the uniqueness of /s/ is due to the fact that it is the only consonant to be at the same time **V**-headed like sonorants and **C**-mannered like obstruents.

[1] The use of the term "magic" in the title is an explicit reference to Kaye's "magic licensing" (Kaye 1992).

[2] Note that I am referring to the northern variety of Standard Italian spoken in these regions, not to the regional languages and dialects of the area.

2. The Northern Sibilant

Northern Italian (NI henceforth) differs from Central and Southern Italian, among other things, with respect to the phonological behaviour of /s/. In Tuscan /s/ and /z/ are two distinct phonemes: both can occur intervocalically, but they neutralize in pre-consonantal position, where only /s/ can occur before voiceless obstruents and only /z/ before voiced obstruents and sonorants. In Southern Italian /s/ does not undergo intervocalic voicing but is realized as [z] before voiced obstruents and sonorants. In NI there is only one phoneme, /s/ (like in Southern Italian, unlike in Tuscan). However, it undergoes voicing before voiced obstruents and sonorants (like in the two other varieties) and intervocalically too (Bertinetto and Loporcaro 2005). (1) presents a summary of the distribution of the coronal sibilant in the three varieties.

(1)
casa 'house', *rosa* 'rose'
Tuscan: /kasa/ [ka:sa] vs. /roza/ [rɔ:za]
Southern Italian: /kasa/ [ka:sa] vs. /rosa/ [rɔ:sa]
Northern Italian: /kasa/ [ka:za] vs. /rosa/ [rɔ:za]

Quite notably, /s/ is the only obstruent to undergo voicing assimilation, since other obstruents always maintain their laryngeal specifications. More specifically, in NI, voiceless non-sibilant fricatives and stops maintain the opposition with their voiced counterpart even intervocalically: /f/ vs. /v/, as in *afa* 'sultriness' vs. *ava* 'ancestor-fem.', /t/ vs. /d/, as in *rito* 'rite' vs. *rido* 'laugh-1sg-pres.ind.', /p/ vs. /b/, as in *pupe* 'pupae'vs. *pube* 'pubis', /k/ vs. /ɡ/, as in *dica* 'say-subj.pres.' vs. *diga* 'dam'. Minimal pairs involving affricates are marginal, but they do exist, e.g., *razza* [rat:sa] 'race' vs. *razza* [rad:za] 'ray (fish)', *mocio* [mɔtʃo] 'mop' vs. *mogio* [mɔdʒo] 'dejected'. Table 1 presents the obstruents inventory of NI.

	Bilabial	Labiodental	Dental/ Alveolar	Post-Alveolar/ Pre-Palatal	Velar
Stops	p b		t d		k ɡ
Affricates			ts dz	tʃ dʒ	
Fricatives		f v	s [z]	ʃ	

Table 1. **NI obstruent inventory**

As shown in the table, NI possesses two sibilant fricatives, both phonologically voiceless, since /ʒ/ only appears in loanwords and [z] only as an allophone of /s/. However, /ʃ/ does not display the same properties as /s/. On the contrary, its distribution is very limited: it prefers to appear intervocalically and never precedes another consonant. When it occurs word-initially, it selects the definite article allomorph *lo*, which normally appears before heterosyllabic clusters. This fact is normally explained by positing that /ʃ/ is inherently long (together with /ʎ, ɲ, ts, dz/), although in NI it is rarely realized phonetically as a geminate. There is a number of potential minimal pairs whose meaning can be disentangled based on the voicing of /s/, such as *ri*[s]*entire* 'to hear/feel again' vs. *ri*[z]*entire* 'to be affected', but this distinction is not common to all speakers and, more importantly, depends on morphology and not on phonology: *ri-* is an iterative prefix and therefore in *ri*[s]*entire* there is a morphological boundary before /s/ preventing it from undergoing voicing.

3. The Ambiguous Nature of /s/

3.1. /s/, an obstruent just like the others

In languages with a laryngeal opposition in obstruents, /s/ normally has its voiced counterpart /z/. That is the case in French, English, German, Slavic languages, etc. Like other obstruents, it undergoes word-final devoicing in languages where this phenomenon occurs, e.g., Polish *bez* [bɛs] 'without', *bezbarwny* [bɛzbarvnɨ] 'colorless, without color'. /s/ can undergo debuccalization, a phenomenon which typically targets obstruents, e.g., American Spanish *estar* [ehtar] 'to be, to stay', cf. European Spanish [estar].

3.2. /s/, a strange kind of liquid

Even though /s/ is phonetically realized as an obstruent, it does not always pattern with this class. There is evidence that /s/ shares some properties with the class of sonorants, and, in particular, with liquids. Historically, /z/, the voiced counterpart of /s/, could undergo lenition intervocalically and become /r/ (rhotacism), e.g., Proto-Indo-European **ausus* < Latin *aurora*, cf. Ancient Greek *eos*. Similarly, Proto-Germanic **wesanan* gave Modern English *was*, *were*. The existence of this process suggests that the internal structure of /r/ and /s/, at some point in history, must have been somehow similar. /s/ can also transform into sonorants other than /r/. For

instance, Goddard (2001) and Jacques (2013) report that in Arapaho, an Algonquian language, /s/ gradually changed into /n/.

The relationship between /s/ and sonorants is not visible only in diachronic processes. In NI, any consonant can appear in the onset, but only sonorants are allowed to occur in the coda, e.g., *alto* /al.to/ 'tall', *arto* /ar.to/ 'limb', *unto* /un.to/ 'anointed', *ampio* /am.pjo/ 'wide'[3]. The coda position can also be occupied by the first half of a geminate and, crucially, by /s/, e.g., *asta* /as.ta/ 'auction'. Put differently, /s/ is the only obstruent in NI that can occupy a coda position without being the first half of a geminate. This phonotactic distribution brings further evidence that /s/ and sonorants must be melodically related.

3.3. /s/, sonority's black sheep

Besides sharing some characteristics with both obstruents and sonorants, /s/ is also the only consonant that violates the Sonority Sequencing Principle (SSP henceforth), a striking fact for the otherwise unproblematic Italian phonotactics. The SSP, states that, syllable-initially, sonority rises and, syllable-finally, it falls. Each class of segments is assigned a sonority value, according to the Sonority Hierarchy. There exist many versions of the Sonority Hierarchy. In (2) I report the one proposed by Selkirk (1984).

(2)
low vowels > mid vowels > high vowels > r > l > nasals > voiced fricatives > voiceless fricatives > voiced stops > voiceless stops

In spite of the SSP, there exist languages with a very permissive phonotactics (anything-goes languages, as defined by Ségéral and Scheer 2001), such as Slavic languages. But even languages that only allow sonority-rising clusters word-initially tend to tolerate sibilant + obstruent clusters (henceforth ST), e.g., English *style, strange*, German *Skandal* 'scandal', *spielen* 'to play' [ʃpiːlən], *Stelle* 'place' [ʃtɛːlə], French *style* 'style', *sphère* 'sphere'. Morelli (1999) points out that ST is the unmarked obstruent cluster word-initially. If a language allows obstruent clusters word-initially, then it surely allows ST. As a matter of fact, in many languages, word-initially, ST is the only tolerated obstruent cluster, e.g., Dutch (De Schutter 1994), Lithuanian (Tankeviciute and Strimaitiene 1990), Isthmus

[3]Note however that /m/ only appears before labial consonants, or better, the opposition between /n/ and /m/ is neutralized in pre-consonantal position, since nasals always agree in place of articulation with the following consonant.

Zapotec (Marlett and Pickett 1987), Haida (Lawrence 1977), Misantla Totonac (MacKay 1994), Telugu (Nagamma Reddy 1987), Yuchi (Crawford 1973), etc. In particular, /s/ appears much more often than other sibilants as the first member of an obstruent cluster.

4. Previous Accounts of the Uniqueness of Sibilants

4.1. A phonological solution: /s/ is in the rhyme

Depending on the analysis, fricatives have been considered either as sonorous as stops or more sonorous. Either way, ST clusters violate the SSP, since in the first case they would represent a sonority plateau and in the second case a sonority reversal. So where does initial /s/ belong? The traditional phonological analysis treats /s/ in ST sequences as extrasyllabic, i.e., it does not belong to the onset but is attached to higher prosodic units (cf. Iverson 1990, Vaux and Wolfe 2009). As a matter of fact, ST clusters behave differently from, say, obstruent + sonorant clusters (henceforth TR), as some data from English and Italian show (examples taken from Kaye 1992):

(3)

a. British English (London):
knew [nju:] vs. *blew* [blu:] vs. *stew* [stju:]

b. Italian:
il cane 'the dog' vs. *il treno* 'the train' vs. *lo stato* 'the state'

(3a) shows that in this variety of English an onset can be occupied only by two consonants, so [ju:] is not tolerated after [bl] because that would imply a sequence of three consonants before the nucleus. The fact that [ju:] is free to occur after [st] proves that /s/ is not part of the onset. Similarly, in Italian, the definite article *il* is selected before both simple and complex onsets, provided that the complex onset is tautosyllabic. Since /s/ cannot be syllabified in the onset, *stato* selects *lo*, the allomorph that allows /s/ to be resyllabified as a coda: /los.ta.to/. Standard Italian exhibits another phenomenon, called *Raddoppiamento (Fono)Sintattico* '(phono-)syntactic doubling' (RS henceforth), where some monosyllabic words (e.g., *è* 'is', *ha* 'has') and some oxytone words (e.g., *città* 'city') trigger the gemination of the first consonant of the following word. RS applies if the following consonant belongs to a tautosyllabic onset, as in (4a), but fails otherwise, because the coda position is already occupied, as in (4b).

(4)

a. RS: *ha fame* [af:ame] 'he/she is hungry', *ha freddo* [af:red:o] 'he/she is cold'

b. No RS: *ha spazio* [aspat:sjo] (*[as:pat:sjo]) 'he/she has space'

These and other reasons led Kaye (1992: 13) to conclude that in ST clusters /s/ does not belong to the onset but to a preceding rhyme. However, the question of the uniqueness of /s/ as opposed to other obstruents remains: why is it always /s/, and not say, /f/, to behave this way?

4.2. A phonetic explanation: acoustic salience

Some scholars suggest that the peculiar behaviour of sibilants can only be accounted for by considering their acoustic salience. Henke *et al*. (2012) replace the traditional SSP with the interaction of two factors: Cue Robustness and Cue Precision. They define the former "as the degree to which the presence of a segment, and that segment's contrastive information, is likely to be apprehended by a listener under normal listening conditions" and the latter as "the degree to which the cue narrows the field of segmental contenders" (Henke *et al*. 2012: 72-73). Expressed differently, Cue Robustness is the acoustic salience of a segment *per se*, whereas Cue Precision depends on how much a segment is dissimilar from other segments. Under both aspects, sibilants are optimal, since they are very easily audible and can easily be discriminated from both stops and non-sibilant fricatives. As a matter of fact, the centre of gravity (COG henceforth, basically corresponding to the mean frequency) of sibilants is generally higher than that of labial and dorsal fricatives. A study conducted by Gordon *et al*. (2002), comparing fricatives of several languages, shows that sibilants always display a higher COG with respect to other fricatives, with [s] being the most intense. Henke *et al*.'s model also takes into account Modulation, a concept proposed by Ohala and Kawasaki-Fujimori (1997), which basically corresponds to the amplitude and the spectral change triggered by a combination of sounds. For example, even though [s] and [ʃ] are both highly salient, a sequence such as [sʃa] would not have a great modulation and thus would probably be harder to identify correctly than, say, [sta]. Cue Robustness, Cue Precision and Modulation, taken together, predict that liquids and nasals are optimally audible both in pre- and post-vocalic position and that sibilants, unlike non-sibilant fricatives, maintain their audibility even in pre- and post-consonantal position (Henke *et al*. 2012: 78). Phonetic factors, such as ease of articulation and acoustic salience, are surely responsible for the diachronic development of

phonological systems (cf. Blevins 2004), but fail to explain phenomena such as those described in (3) and (4). Moreover, it is not clear why other segments with rich acoustic cues, such as liquids and nasals, are not as free as sibilants when it comes to their phonotactic distribution.

5. CVCV and Element Theory

My analysis is couched in the theoretical framework of CVCV (Lowenstamm 1996, 1999, Scheer 2004), an offspring of Government Phonology (Kaye 1990). In CVCV the skeleton is a sequence of non-branching onsets and nuclei, as show in (5). Consequently, concepts such as coda or rhyme are dispensed with. What is traditionally called coda in CVCV is nothing but an onset followed by an empty nucleus. A word like Italian *con* 'with' is thus represented as in (6), with a final empty nucleus, and *carta* 'paper', as in (7), with an internal empty nucleus.

(5) *caro* 'dear'

C V C V
| | | |
k a r o

(6) *con* 'with'

C V C V
| | |
k o n ø

(7) *carta* 'paper'

C V C V C V
| | | | |
k a r ø t a

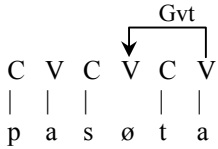
A branching onset is represented as a sequence of two onsets interrupted by an empty nucleus, as in (8).

(8) *tra* 'between'

C V C V
| | |
t ø r a

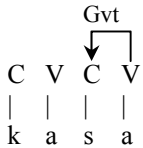
CVCV, as a result of its own architecture, has to posit a great number of empty positions that need somehow to be restrained. It is important to point out that empty nuclei do not come for free; some conditions have to be met. CVCV assumes the existence of two lateral forces (all relationships are lateral in this framework): Government (Gvt) and Licensing (Lic). Both forces proceed from right to left. Government is an inhibiting force, meaning that it spoils the nature of its target. On the contrary, if a position is licensed, it is somehow corroborated and acquires (or maintains its) strength. There are at least two kinds of government: V-to-V government and V-to-C government. The former, as shown in (9), silences an empty nucleus, preventing it from being phonetically realized, whereas the latter is responsible for lenition, as in the example given in (10).

(9) V-to-V Government: if a full nucleus governs a preceding empty nucleus, it silences it (it is not phonetically interpreted)



[pasta] *pasta* ‘pasta, dough’

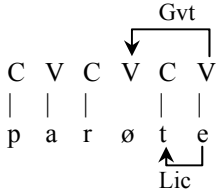
(10) V-to-C Government: if a full nucleus governs a C position, it spoils its consonantness and makes it more vocalic (i.e. more sonorous)



[kaza] *casa* ‘house’

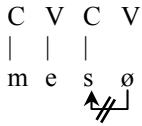
Licensing is the force responsible for consonantal strength. For instance, in the example given in (11), the post-consonantal [t] in *parte* is licensed and ungoverned, thus being exempt from lenition. Lack of licensing, in certain languages, can trigger debuccalization, as shown in (12).

(11) Licensing: if a full nucleus licenses a preceding C, it gives it strength



[parte] *parte* ‘part’

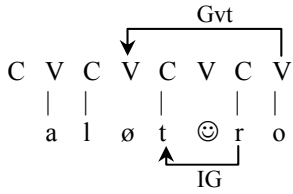
(12) Lack of licensing: if a C is unlicensed, it is likely to lose some of its melody (i.e., undergo debuccalization)



[meh], *mes*, American Spanish 'month'

Given a TøR sequence (an obstruent followed by an empty nucleus and a sonorant), R can govern the preceding T thus silencing the empty nucleus comprised in this closed domain. As a result, that empty nucleus does not need to be governed by a following full nucleus anymore. Note that only sonorants can govern obstruents and not the other way around, since sonorants are melodically richer. This type of special government is called Infrasegmental Government (IG). An example is given in (13).

(13) Infrasegmental Government



[altro], *altro* 'other'

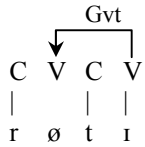
Note that not all obstruents can participate to Infrasegmental Government: crucially, /s/ cannot, since its melody is the same as that of sonorants. This fact begs the question why T/s/ clusters do not behave like other branching onsets. As a matter of fact, in Italian, /ps/ and /ks/ clusters are attested word-initially in some words of Greek origin, but they do not behave like TR clusters, e.g., they select *lo* instead of *il* as the definite article allomorph. The answer probably lies in the consonantal manner elements present in /s/ and absent from sonorants.

Ségéral and Scheer (2001) divide languages into two types: anything-goes languages (e.g., Czech, Moroccan Arabic, etc.) and initial-CV languages (e.g., Italian, English, Spanish)[4]. What differentiates the first group from the second is the way the morphological boundary "beginning of the

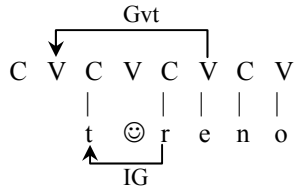
[4] As Passino (2013) points out, a third type of languages should be taken into account, namely those that exhibit word-initial TT, RR clusters (i.e., tolerate sonority plateaus) but do not have RT clusters (i.e., do not tolerate sonority reversals). Languages potentially belonging to this group are, for example, the Emilian and Piedmontese dialects spoken in Northern Italy.

word" (traditionally represented by #) is translated into phonology (Lowenstamm 1999). In anything-goes languages, phonology is simply blind to # so there are no particular phonological phenomena occurring at the beginning of the word and potentially any cluster can appear word-initially. An example, given in (14), is the word *rty* 'lips' in Czech. On the contrary, in initial-CV languages # is translated into an empty CV sequence and this has interesting consequences: only #TR clusters are admitted word-initially (#TT, #RR, #RT sequences are ruled out) and the word-initial and the internal post-consonantal position display a similar behaviour, e.g., they are the locus of fortition and/or they escape lenition. In (15) I give the example of the Italian word *treno* 'train', where an empty CV unit precedes the TR cluster.

(14) Czech *rty* 'lips'



(15) Italian *treno* 'train'



In (14) there is no initial CV, so even if the cluster /rt/ implies a sonority reversal (a sonorant precedes an obstruent), the word is pronounced anyway, since a full nucleus is able to govern the empty nucleus between the sonorant and the obstruent. Conversely, in (15), the empty nucleus of the initial CV must be governed and that task is fulfilled by the first available full nucleus. This implies that a possible word-initial consonant cluster can only be a sequence of an obstruent and a sonorant. One of the greatest achievements of the theory is that it manages to capture the relationship between word-initial and post-consonantal position, in that they are both strong, i.e., a potential context for fortition processes. This strong position is defined by Ségéral and Scheer (2001) as the mirror of the coda, i.e., the Coda Mirror. Similarly, both the coda position and the intervocalic one are

weak, but they are so in different ways. Table 2 gives an overview of the effects of Government and Licensing on the different syllabic positions.

Position of C	Strong vs. Weak	Lateral forces	Typical processes
Word-initial	Strong in initial-CV languages; weak otherwise	Licensed and ungoverned in initial-CV languages; governed otherwise	Fortition in initial-CV languages (e.g., j → dʒ, as in Latin *ianuariu* → Italian *gennaio* 'January', Alkire and Rosen 2010: 53)
Intervocalic	Weak	Governed	Voicing (e.g., t→ d, as in Latin *strata*→ Italian *strada* 'street', Alkire and Rosen 2010: 47) Spirantization (e.g., p → ɸ, as in Tuscan Italian [p]*asta* vs. *la* [ɸ]*asta*, Marotta 2008) Approximantization (e.g., p→ w, as in 10th century Japanese *kapa* → *kawa* 'river', Frellesvig 2010) Rhotacism (see examples in 3.2)
Internal coda	Weak	Unlicensed, ungoverned	Debuccalization (e.g., Caribbean Spanish *di*[h]*ko* 'disk', Shepherd 2003: 61) Voicing assimilation(e.g., Italian *te*[s]*to* 'text' vs. *a*[z]*ma* 'asthma', Bertinetto and Loporcaro 2005: 134)
Word-final	Weak	Unlicensed, ungoverned	Debuccalization (e.g., s → h, as in Caribbean Spanish *do*[h] *ala*[h] 'two wings', Shepherd 2003: 61) Devoicing (e.g., d → t, as in German *Hun*[t] 'dog' vs. *Hun*[d]*e* 'dogs', Stampe 1979)
Internal, post-consonantal	Strong	Licensed, ungoverned	Fortition (e.g., r →t^h, as in Setswana /n+rapa/ → [nt^hapa] 'love me', Zsiga *et al*. 2006)

Table 2. **Strong vs. Weak positions**

5.1. Element Theory

Element Theory goes back to Kaye *et al*. (1985) and differs from mainstream generative phonology in many aspects, the most important of which is that phonological primes are not binary but privative. These primes are based on acoustic characteristics (and not on articulatory ones), are directly interpretable, and function as abstract, cognitive entities. Elements are autosegments organized in tiers and their combinations are phonetically interpreted as vowels and consonants. Elements establish relations with each other, in which normally one element is prominent (i.e.,

the head) with the respect to others (one or more operators). The number and type of primes depends on the author. In (16) I present the ones employed by most scholars (cf. Harris 1990, Scheer 1999, Backley 2011).

(16)	A	lowness/RTR	[a]
	I	palatality/frontness	[ɪ]
	U	if headed, labiality; if non-headed, velarity	[ʊ]
	ʔ	stopness/occlusion	[ʔ]
	h	aperiodic noise/frication	[h]
	H	voicelessness/high tone	
	L	nasal murmur/voicing/low tone	

In order to account for the fact that /s/ patterns with both obstruents and sonorants, Scheer (1999, 2004) proposes that its internal structure contains **h** on the manner tier (just like other fricatives) and **A** and **I** on the melody tier, with **A** as the head (just like /l, r, n/). The internal structure of /s/ is shown in (17) and those of sonorants in (18).

(17) Structure of /s/

Skeletal tier	C
	|
Manner tier	h
	|
Melody tier	A
	|
	I

(18) Structure of sonorants

Skeletal tier	C	C	C
	|	|	|
Manner tier	|	T	N[5]
	|	|	|
Melody tier	A	A	A
	|	|	|
	I	I	I
	[l	r	n]

[5] In Scheer's analysis, T is the prime identifying the trills and N stands for nasality.

5.2. Element Theory: an impoverished version

In CVCV (and the related VC phonology, cf. Szigetvári 1999: 62, Dienes and Szigetvári 1999), the inherent nature of C is consonantness / quietness, as opposed to V, whose nature consists in loudness. C is typically associated with **ʔ** and V with **A**. The most sonorous vowel [a] consists of headed **A**. The most salient obstruents, i.e., sibilants, contain **A**, as well as nasals. **A** is the head in both coronal sonorants and /s/. Sonorants and vowels are both triggers of voicing assimilation in NI, and this is a challenge for the theory if one posits that vowels and sonorants do not possess **L** or any other primes indicating voicing (see Cyran 2011 for similar problems in Polish). Intuitively, **A** (standing for sonority, loudness), **L** (standing for nasality and voicing) and V (the vocalic slot in the skeleton) are connected. Already Dependency Phonology (Anderson and Ewen 1987) and Radical CV phonology (van der Hulst 1994) treated **V** as the element bound to be interpreted as sonority, voicing and vocalicness, depending on its position in the structure. I therefore propose to dispense with **A**, **ʔ**, **h**, **L** and **H** altogether and to only maintain **C**, **V**, **I** and **U**. Note that in Radical CV phonology C and V do not refer to skeletal units but only act as elements (van der Hulst 1994: 439), whereas in my model they can be both. **I** and **U** are allowed to occur only on the melody tier, whereas **C** and **V** are bound to be interpreted differently depending on the tier where they appear (skeletal tier, manner tier or melody tier). Their phonetic realizations are given in (19).

(19)

Skeleton. C and V identify, respectively, consonants and vowels.

Manner tier. **C** (i.e., headed **C**) indicates complete occlusion (a stop), whereas **C** (non-headed **C**) indicates partial occlusion (a fricative). **C,V** is interpreted as a voiced stop and **C,V** as a voiced fricative. **V** is interpreted as total absence of occlusion (a vowel), whereas **V** characterizes non-nasal sonorants and **V,C** nasal ones.

Melody tier. **V** in isolation is interpreted as [a], **V** as schwa. **I** and **U** maintain their traditional value, i.e., acuteness and graveness. **C** probably could be used to identify some glottalized vowels but it may also be the case that **C** is banned from the melody tier (which would be consistent with the fact that melody and occlusion are conceptually opposite).

As shown in (19), the tiers are three: the skeleton, the manner tier and the melody tier. I propose that the hierarchy of tiers be very strict, i.e., skeleton – manner tier – melody tier. This implies that the manner tier is central and communicates with both the skeleton and the melody tier, but the skeleton has no direct access to the melody tier and vice versa. This is desirable for the theory because manner of articulation seems to be acoustically more salient than place in the identification of consonants. In (20) I show the internal structure of a number of vowels and consonants according to this impoverished version of Element Theory.

(20) *Vowels and glides*

Skeleton	V	V	V	V	V	C	C
	|	|	|	|	|	|	|
Manner	V	V	V	V	V	V	V
	|	|	|	|	|	|	|
Melody	V	I	U	V,I	V,U	I	U
	[a]	[i]	[u]	[e]	[o]	[j]	[w]

Obstruents

Skeleton	C	C	C	C
	|	|	|	|
Manner	C	C,V	C	C
	|	|	|	|
Melody	U	U	U	V,I
	[p]	[b]	[ɸ]	[s]

Sonorants

Skeleton	C	C	C	C	C
	|	|	|	|	|
Manner	V	V	V	V,C	V,C
	|	|	|	|	|
Melody	V,I	V,I	V,I	V,I	U
	[l]	[r]	[ʎ]	[n]	[m]