

Domain modelling in Optimality Theory: Morphophonological cyclicity vs. stepwise prosodic parsing¹

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This paper examines opaque examples of phrase-level phonology taken from Chilean Spanish under the framework of Stratal Optimality Theory (OT) (Rubach 1997; Bermúdez-Otero 2003, 2019) and Harmonic Serialism (HS) (McCarthy 2008a, b, 2016). The data show an interesting double repair of the coda /s/ taking place at word edges. It is argued that Stratal OT is superior in modelling phonological processes that take place at the interface between morphology and phonology because it embraces cyclicity. Under this model, prosodic structure is built serially, level by level, and in accordance with the morphological structure of the input string. In this way, opacity at constituent edges can be solved. Stratal OT also provides insight into word-internal morphological structure and the domain-specificity of phonological processes. It is demonstrated that a distinction in this model is necessary between the word and the phrase levels, and between the stem and the word levels. As illustrated by the behaviour of Spanish nouns, affixation and the resultant alternations inform us about the domains to which both morphological and phonological processes should be assigned. Against this background, Harmonic Serialism embraces an apparently simpler recursive mechanism in which stepwise prosodic parsing can be incorporated. What is more, it offers insight into the nature of operations in OT, as well as into such problematic issues as structure building and directionality. Nevertheless, despite the model's ability to solve various cases of opacity, the need to distinguish between two competing repairs makes HS fail when confronted with the Chilean data under examination.

KEYWORDS: Chilean Spanish, Harmonic Serialism, opacity, Optimality Theory, Stratal OT

1. INTRODUCTION

It may seem that generative phonology has come full circle with the rise and development of Optimality Theory (OT). The original version of this framework

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abandoned derivation and rule-based analysis in favour of a model with constraint interaction (Prince & Smolensky 1993/2004).² Strict parallelism and direct input–output mappings seemed to be capable of dealing with many of the phenomena previously attributable to serial structure building. Recent years have shown, however, that we seem to be in need of derivation after all. A thorough study of phonological processes in various language families has led many phonologists to the conclusion that strictly parallel OT is unable to address some of the most complicated problems. As a result, a number of improvements have been proposed to better adjust the theory to linguistic reality. Opacity (Kiparsky 1973, 2013) is one of the most acute problems for parallel evaluations and therefore has become a central concern for phonologists.

In this paper, I compare opacity modelling offered by two competing frameworks: Stratal OT and Harmonic Serialism based on data from Chilean Spanish which show a complicated set of coda /s/ repairs distributed differently in word and phrase-level domains. I argue that Stratal OT (Bermúdez-Otero 2019) has all the necessary means to model opaque interactions of the type presented in Chilean in an explanatory manner. I demonstrate that cyclic domain construction by means of strata that this framework proposes is able to explain both the domains of phonological processes, and the crucial prosody–morphology interactions that lead to opacity. As will be argued in Section 4, cyclic level ordering that assumes different phonological domains and hence different rankings is necessary to account both for the observed stem alternations and for phrase-level discrepancies identified in the Chilean data. Against this background, Harmonic Serialism (McCarthy 2008a, b, 2010b) offers step-by-step candidate evaluation yet results to be unable to render the correct output forms. Although various types of opacity can be predicted and solved within this framework thanks to the use of a prosodic structure building mechanism (e.g. Elfner 2009, Torres-Tamarit 2012), stepwise prosodification proves to be insufficient to account for the Chilean output forms.

The paper is organised as follows. Section 2 presents the data. Section 3 provides an OT analysis of Chilean, pointing to some problems. The data are then checked against the Stratal OT mechanism in Section 4. Section 5 discusses the way the data can be analysed under Harmonic Serialism. Outstanding issues and other approaches are briefly examined in Section 6. Section 7 summarises the discussion and provides some concluding remarks.

2. THE DATA

According to the abundant literature concerning Latin-American dialects, Chilean is considered a non-conservative variety of Spanish that presents interesting combinations of phonetic and phonological phenomena (Henríquez Ureña 1921; Rabanales 1953; Oroz 1966; Cepeda 1990; Lipski 1996). One of the characteristic

[2] Although a harmonic serialist option was mentioned by Prince & Smolensky (1993/2004), it was not pursued in literature in the first years of OT development.

features of Chilean is its advancement in terms of /s/ aspiration and total deletion. According to Cepeda (1990) and Lipski (1996), the rate of /s/ aspiration and deletion is very high across the country and while higher urban classes prefer aspiration, deletion occurs among the lower classes and in rural areas. My analysis focuses on the interaction between these two processes encountered in most speakers, especially in the north of the country.

In order to learn about the actual distribution of /s/ and its allophones in the speech of the inhabitants of the region, I decided to conduct my own fieldwork.³ This consisted of semi-structured interviews with three male native speakers of Chilean living in Poland (Poznań and Warsaw), aged 30, 32 and 32 years. The conversations lasted 47, 17 and 55 minutes, respectively, and were recorded in early 2011 with the use of a Sony ICD-UX200 digital mp3 recorder and a standard microphone. The speakers were asked questions about their background, reasons for coming to Poland and their lives in the country. Whenever possible, they were allowed to speak freely without much guidance. This is due to the fact that the studied phenomena involve connected speech at word boundaries. As I wanted to gather spontaneous, uninhibited speech, reading lists or elicitation would not be the correct technique. The recordings were subsequently analysed auditorily and acoustically. Furthermore, they were supplemented by video material taken from news reports and programmes involving conversations with policymakers and other native speakers from northern Chile. All the analysed programmes were broadcast on ITV (TV channel from the Iquique region). A total of 126 minutes and 36 seconds of video material was downloaded as audio files and analysed. This includes 13 female and 16 male voices heard on 15 different audio excerpts. All the audio-visual material was gathered on 31 January 2011. Fragments of both fieldwork recordings and transcribed televised material are provided in the [Appendix](#). The data listed below were produced by these speakers. Additionally, the data were consulted with Hernán Emilio Pérez Muñoz, a phonetician from the University of Concepción specialising in studying the acoustics of Chilean, including the behaviour of /s/. Dr Pérez confirmed the generalisations based on the gathered material.⁴ Most importantly, it should be noted that spontaneous productions feature both aspiration and deletion of the underlying /s/ in this dialect in the configurations presented below. However, the process should be treated as sound change in progress that is sensitive to social factors. The underlying /s/ does surface occasionally, triggered by pauses and hesitations, phrase-final emphasis and in some words (e.g. given names which are easily confusable with other items,

[3] The data presented in the paper have also been discussed in my Ph.D. dissertation (Broś 2015).

[4] As already mentioned, my research is based on the dialect spoken in the north of Chile. Whether the same generalisations apply in the case of other regions requires further study. However, due to the fact that Chilean presents scarce regional variation and according to Mr Pérez' intuitions concerning the central and southern parts of the country, it is possible that the whole of Chilean presents the same phenomena.

or names of weekdays). This, however, is not systematic in connected speech.⁵ Thus, single words produced in isolation have the following surface forms in Chilean.

(1) *Word-medial and word-final coda /s/ in Chilean*

(a) Word-medial coda /s/ aspiration

este 'this' [éh.te]
 festival 'festival' [feh.ti.βál]
 desde 'from' [déh.ðe]

(b) Word-final coda /s/ deletion

tres 'three' [tré]
 vez 'time' [bé]
 veces 'times' [bé.se]

In (1), /s/ aspiration can be observed inside words while deletion prevails word-finally. Note that there are no alternations in the words of (1a) type. It may be therefore assumed that /h/ is underlying rather than derived in these stems. This is a plausible argument given the fact that the forms [es.te] and [eh.te] do not seem to alternate across speech rates in this dialect. The argument could be extended to some inflectional morphemes, such as the 1st person plural *-mos* in verbs or the plural marker *-s*. Nevertheless, I assume underlying /s/ in these forms given that there is variability in word-final position in careful speech, and sociolinguistic studies suggest that /s/ is present in the underlying representation (UR) of inflected words.⁶

[5] A referee suggests that apart from changes in the fricative in question, changes in the preceding vowel should also be considered. Indeed, in some varieties of Spanish, especially Andalusian, the deletion of /s/ results in changes in the preceding vowel's quality (e.g. Navarro Tomás 1938, Figueroa 2000, Lloret & Jiménez 2009, Carlson 2012). In the data analysed here, no systematic lengthening effects or changes in vowel quality were observed. Yet, given the nature of the study, it cannot be determined whether phonetic cues affecting the pronunciation or perception of the preceding vowel exist. Such a study would require a controlled production and perception study designed specifically for the purpose of measuring possible allophonic effects of /s/ weakening. There is no such study on the Chilean variety and, to the best of my knowledge, there is no mention of allophonic vowel changes in the contexts discussed in the existing literature. If any effects were discovered for this variety, their phonological status would need to be determined before one could pursue this issue by means of a formal analysis. If the observed changes were contrastive, an OT analysis would be able to grasp them as a compensatory effect.

[6] This is confirmed by differences in production according to situation and speech rate (style, register), and by the fact that aspiration and deletion of /s/ is highly stigmatized in many Spanish-speaking countries. Pérez (2007), for example, provides a phonetic and sociolinguistic analysis of the realization of /s/ in Chilean, concluding that the [s] variant is an indicator of non-spontaneous speech, while elision indicates spontaneous speech across styles. The results confirm other studies (e.g. Cepeda 1990, 1995; Oroz 1966; Borland 2004; Soto-Barba 2011) and point to the existence of low and high prestige variants of the phoneme /s/. From the point of view of learnability, native speakers must be exposed to the [s] variant when acquiring the language. This is probably dictated by orthography and scholarisation, although I expect the

As for /s/-final stems, alternations can be observed, which is a clear indication of the presence of /s/ in the UR, as in *vez* ‘time’ – *veces* ‘times’ (1b) or *mes* ‘month’ – *meses* ‘months’ and similar words. We can clearly see that the /s/ is realised either as a [s] when in the onset or as [∅] when in the coda. The situation is further complicated when resyllabification comes into play in phrase phonology.

As demonstrated in (2), Chilean presents an interesting interaction of coda /s/ aspiration and deletion.

(2) *Word-final coda /s/ across a word boundary in Chilean*

(a) Deletion before a consonant

las celebraciones ‘celebrations’	[la.se.le.βra.sjó.ne]
las normativas ‘the rules’	[la.nor.ma.tí.βa]
otros términos ‘other aspects’	[ó.tro.tér.mi.no] ⁷
todos mis documentos ‘all my documents’	[to:.mi.ðo.ku.mén.to]
tres meses ‘three months’	[tré.mé.se]

(b) Aspiration before a vowel

principales estrategias ‘principal strategies’	[prin.si.pá.le.heh.tja.té.xja]
otros espacios ‘other areas’	[ó.tro.heh.pá.sjo]
estamos en estudios ‘we are analysing’	[eh.tá.mo.he.neh.tú.ðjo]
términos económicos ‘economic terms’	[tér.mi.no.he.ko.nó.mi.ko]
todas aquellas regiones ‘all those regions’	[tó.ða.ha.cé.ja.re.çjó.ne]

Across a word boundary, /s/ is lost before a consonant (2a), similarly to the /s/ in isolated words before a pause (1b). Before a vowel, however, an opacity effect is observed (2b). Due to resyllabification, the coda segment is forced into the empty onset position of the following word, but its featural specification changes in the process. It is thus /h/ that surfaces as the onset of the following word – a visible trace of /s/ aspiration with no manifest motivation in a surface-based approach. The general conclusion provided by the above data is therefore that depending on the context the /s/ can be realised faithfully as [s] or in its weakened form: [h] or [∅].

3. CHILEAN SPANISH DUAL-REPAIR PATTERN

Coming back to the Chilean data, it is worth looking at how they can be analysed in OT and what problems arise in a standard OT evaluation. This is the aim of this section.

/s/ of such forms to disappear from the URs in the future, given the prevalence of weakened pronunciations across speech rates.

[7] Note that in Chilean Spanish, the sequence /tr/ tends to be pronounced [tɾ]. Nevertheless, in my data, this phenomenon is variable. Some speakers present this pronunciation at times, while others do not. The transcriptions in the text and the tableaux are consistent with the transcriptions in the [Appendix](#).

As observed in (1)–(2), Chilean Spanish allows for more than one repair strategy when dealing with the illicit coda /s/, depending on the context. What is more, these strategies take the form of phonological processes that interact with syllabification and refer to higher prosodic (and morphological) constituents. While deletion is banned word-internally, it is the default strategy at word edges, unless inhibited by resyllabification. This can be presented in the form of a derivation that shows the order of the events, as in (3) below. For the purposes of the analysis, the best way of examining all of the processes together is to choose one phrase that presents each type of change. In this way, the interactions between all the relevant constraints can be shown at once in a single tableau.

Let us thus focus on an excerpt of the phrase ‘And I became an actress once again’ (*Y me he vuelto otra vez actriz*, literally ‘and I have turned another time actress’), in which the target sequence is *vez actriz* pronounced [bé.hak.trí].⁸ In a derivational account, a proper rule ordering where aspiration applies first and deletion follows, but only after resyllabification has applied, is required. This is demonstrated in (3).

(3) *Rule-based account of Chilean aspiration-cum-deletion*

/bes/ + /aktris/	UR
[bes].[ak.tris]	SYLLABIFICATION
[bés].[ak.trís]	STRESS ASSIGNMENT
[béh].[ak.tríh]	ASPIRATION
[bé.h][ak.tríh]	RESYLLABIFICATION
[bé.h][ak.trí∅]	DELETION

As presented above, given that the first /s/ of the word (*vez* [bé], alternating in the plural with *vecés* [bé.se]) is opaquely debuccalised to [béh], and the coda /s/ of the second word (*actriz* [ak.trí] ‘actress’, alternating in the plural with *actrices* [ak.trí.se]) is deleted before a pause. Thus, the derivation requires extrinsic rule ordering.⁹ Rule ordering helps render the correct surface form despite the lack of transparency and the application of two different repair processes in response to the illicit segment. In a parallel account, however, such a solution is not available. The intermediate stage of /s/ aspiration across a word boundary before a vowel is not visible on the surface, hence the resultant change from /s/ to [h] is opaque (opacity by overapplication, Wilbur 1973). If Spanish debuccalisation is triggered

[8] If we take the whole phrase into account, the actual pronunciation is [βé.hak.trí], with an initial approximant. This is due to the fact that /b/ is preceded by a vowel (*otra*). I ignore this process, however, as it is irrelevant for the analyses presented in this paper and might confuse the reader. In the evaluations shown in this paper, the /b/ of *vez* /bes/ does not stand in a position in which approximantisation applies.

[9] In the latter case, the same effect would ensue before a consonant (e.g. *una actriz maravillosa* [u.nak.tri.ma.ra.βi.jó.sa] ‘a marvellous actress’).

by a coda condition against /s/, as is commonly believed, there is no motivation for it in (2b).

Given the extended opacity effects identified in (2) above, one can predict that a ranking paradox will ensue. This is because /s/ aspiration requires IDENT(PI), a constraint mandating place identity between the input and the output, to be ranked lower than MAX(Seg), a constraint banning deletion, while /s/ deletion requires the opposite. Before demonstrating this in a tableau, let us analyse the constraints involved in generating aspirated and deleted output forms:

(4) *Constraints taking part in /s/ aspiration and deletion*

*S]CODA /s/ is banned from the coda. (Kenstowicz 1996)¹⁰

IDENT(PI) The place features of the input must be preserved in the output.

MAX(Seg) The input segment must have a correspondent in the output (no phonological deletion).

The ranking *S]CODA ≫ IDENT(PI) is necessary to render aspiration, while the ranking *S]CODA ≫ MAX(Seg) is responsible for generating coda /s/ deletion. The mutual ranking of the two faithfulness constraints is problematic, however. The tableaux in (5) show that the two constraints militate against each other.

(5) *Ranking Paradox in standard OT*

(i) Evaluation of *actriz* ‘actress’ (deletion)

/aktris/	*S]CODA	IDENT(PI)	MAX(Seg)
a. ak.tríh		*!	
b. ak.trís	*!		
c. \emptyset ak.trí			*

(ii) Hypothetical mapping *actriz* → [ak.trih] (aspiration)

/aktris/	*S]CODA	MAX(Seg)	IDENT(PI)
a. \emptyset ak.tríh			*
b. ak.trís	*!		
c. ak.trí		*!	

As demonstrated in (5), two contradictory rankings are necessary to account for deletion (5i) and aspiration (5ii), respectively. With the two processes occurring simultaneously in the same dialect, the mapping *vez actriz* → [bé.hak.trí] seems

[10] The familiar process of Spanish /s/ aspiration is typically described as positionally-conditioned segment weakening, i.e. a coda condition against /s/ (e.g. Harris 1983, Lipski 1999, Shepherd 2003) whereby the illicit coda is debuccalised to [h]. Deletion is another consequence of /s/’s illicit position. I follow this approach in this paper. Also, the reader should know that I use the term DEBUCCALISATION (loss of place features) as a synonym of ASPIRATION. The latter is typically used in the Spanish language literature describing the change /s/ > [h].

impossible to generate by the system without reranking. Note that in this case resyllabification is involved. In OT, this process is typically described as governed by ONSET, which mandates that empty onset positions be filled at all cost, even if this leads to the misalignment of the stem with the syllable boundary. The relevant constraints are presented below.

(6) *Constraints active in resyllabification*

- ONSET Syllables must have onsets.
 ALIGN-L(Stem, σ) The left edge of the stem must coincide with the left edge of the syllable.

For resyllabification to be allowed, ONSET must be ranked above ALIGN-L(Stem, σ). Note, however, that in a dialect that presents aspiration across a word boundary the process is rendered opaque by stem misalignment. Once the coda /s/ attaches to the following word as an onset, it automatically ceases to violate *S]CODA, which means that there is no motivation for aspiration. This is demonstrated in (7).

(7) *Evaluation of vez actriz ‘again actress’*

/bes + aktris/	ONSET	*S]CODA	ALIGN(L)	IDENT(PI)	MAX(Seg)
a. bés.ak.trís	*!	**			
b. bé.sak.tríh			*	*!	
c. bé.sak.trís		*!			
d. ^h bé.sak.trí			*		*
e. béh.ak.trí	*!			*	*
f. ^h bé.hak.trí			*	*!	*
g. bé.ak.trí	*!				**

In (7), *S]CODA and ONSET are the highest-ranked constraints, and MAX(Seg) has to be ranked the lowest. Otherwise, deletion would be impossible, and aspiration would ensue against the actual pronunciations. With such a ranking, however, the correct candidate cannot win. As is typical with opacity cases analysed in the OT framework, the transparent candidate surfaces as optimal (7d). Since ONSET mandates resyllabification, the aspiration of the first /s/ is made ‘redundant’ and uncalled for in the desired candidate (7f). Note that (7d) and (7f) differ by one violation of IDENT(PI). This means that no reranking will make a difference – the transparent candidate will always win against such a constraint set. Interestingly, both deletion and aspiration are correctly predicted by the OT mechanism. Although MAX(Seg) is ranked lower than IDENT(PI), rendering deletion seemingly less costly for the grammar, higher-ranked constraints prevent across-the-board elision: filling in empty ONSET positions is prioritised over illicit coda loss. Despite these correct predictions, however, strict parallelism

strips OT of a means to account for non-transparent /s/ weakening across word boundaries.¹¹

In view of the general inability of strictly parallel OT to account for the described surface opacity, a solution must be sought in those frameworks which have proved to be apt at dealing with overapplication. Note that the processes observed in Chilean seem to apply in different domains. First, resyllabification is a phrasal phenomenon as it applies across word boundaries, once individual words are put together by syntax in longer utterances. Second, it does not discriminate between segments as long as there are empty onsets to the right that can be repaired, with a morphophonological side-effect of misalignment between prosodic structure and the morphological word.

Thus, the domain of resyllabification in the sense of misalignment across a word boundary is rather uncontroversial.¹² Since it is a phrase-level process then, naturally, everything that follows it must also belong to this domain (if we assume strata, and derivation). Deletion, which applies only after information on the following sound or lack of it has been provided by syntax, is also a phrase-level process. The question is what status should be assigned to aspiration. It may as well be the same as with the other two processes. Nevertheless, it is not sensitive to word boundaries: it is strictly limited to illicit coda segments and the apparent overapplication is the result of resyllabification and not any segmental neighbourhood provided by phrase phonology. What is more, it can be suspended in some cases (some lexical items, e.g. *lunes* ‘Monday’, emphatic pauses – in which case deletion does not take place either), which means it features exceptions.¹³ At the same time, it must be noted that no overapplication of aspiration takes place at the word level, which means that the process cannot apply earlier than that. If it were stem-level, we would expect to find [h] in morphologically complex words, e.g. plural forms, which is not the case (see also the brief discussion in Section 4.2). Consequently, I assume that the process applies at the word level and not before or after it. It overapplies to word-final /s/ resyllabified into the onset across word boundaries, but never word-internally. With this assumption in mind, let us go on to the Stratal OT analysis of the Chilean data.

[11] In cases with aspiration only, the presented ranking paradox can be solved with sympathy (McCarthy 1999). I am not presenting it here as this framework has been practically deemed obsolete in the literature (but see Broś 2015).

[12] The analysis presented here does not seek to contest the claim that syllable structure can change at other levels. Resyllabification in the sense of adjusting syllable structure within words when affixes are added, or in the sense of Kaisse’s (1999) ‘resyllabification which precedes all segmental rules’ at a given stratum, is a recursive process that requires no explanation in frameworks assuming that prosodic structure is built prior to phonological operations (e.g. Lexical Phonology or Stratal OT).

[13] The presence of exceptions and variability is attributed to lexical rules in Lexical Phonology (Kaisse & Shaw 1985, Kiparsky 1985), which can be considered ‘precursors’ of word-level processes in Stratal OT. For a discussion of variation in phonology and arguments against this diagnostic, see Coetzee & Pater (2011).

4. A STRATAL OT APPROACH

The serial version of OT (Rubach 1997, 2000; 1999, 2003; Bermúdez-Otero 2003, 2006) draws on the insights of Lexical Phonology (Kiparsky 1982, Booij & Rubach 1987) and makes a distinction between stem, word and phrase phonology – or the lexical and the post-lexical components. The basic assumption here is that some processes are limited to the stem, some to the lexical item as a whole, while others are triggered by the syntax and activated at word edges. Because each type of process can be context-sensitive, the input to the word phonology is the output of the stem phonology and not the original input (underlying representation), while the input to the phrase phonology is the output of the word phonology. Morphophonological constituents are concatenated at stratum junctures (e.g. affixes are added or words are parsed into phrases). As we pass from one level to another, the constraint set is reranked to adjust to the demands of the grammar. At the word level, certain segmental phenomena which were mute at the stem level may be triggered (e.g. aspiration). At the level of the phrase, reranking gives rise to a series of *sandhi* and phonostylistic phenomena, among others.¹⁴ Most importantly, constraint reranking is the only modification with respect to the standard version of OT. There are no additional mechanisms in the form of special-status constraints, restraints on GEN or Eval, or output candidate modifications.

4.1 *The word and phrase levels*

Chilean speakers' behaviour confirms the fact that an important distinction must be made at least between word-level and phrase-level phonology. Resyllabification – a strictly phrase-level phenomenon – obscures the process of /s/ weakening, causing opacity. Word-internal structures present different effects than word-edge segments, and the latter are further differentiated based on their immediate contexts to the right in an utterance. This cannot be expressed in a parallel framework, even with the use of alignment constraints designed specially to address this type of domain distinctions.¹⁵ Drawing on the above level/tier division, a word-level phonology may be proposed to generate aspiration only (MAX(Seg) >> IDENT(PI)). This is illustrated in (8).

[14] Several types of level distinctions in Stratal OT have been proposed in the literature. I adopt the model based on the crucial Lexical Phonology and Morphology (LPM) insights revived in OT by Kiparsky (1999) and further developed by e.g. Bermúdez-Otero (2003, 2019).

[15] First, alignment constraints are not in interaction with constraints banning/allowing aspiration and deletion. Second, they are unable to temporarily block processes to resemble 'precedence effects' modelled in rule-based theory.

(8) *Stratal OT word-level evaluation of vez actriz 'again actress'*

 (i) Evaluation of *vez* 'time/again',¹⁶

/bes/	*S]CODA	MAX(Seg)	IDENT(Pl)
a. bés	*!		
b. \emptyset béh			*
c. bé		*!	

 (ii) Evaluation of *actriz* 'actress'

/ak.tris/	*S]CODA	MAX(Seg)	IDENT(Pl)
a. ak.trís	*!		
b. \emptyset ak.tríh			*
c. ak.trí		*!	

In (8), the two words, *vez* 'time/again' and *actriz* 'actress,' are evaluated separately. Both outputs show aspiration. No deletion is observed.

The two words are then combined and fed into the phrase level, which requires a crucial reranking (IDENT(Pl) \gg MAX(Seg)) to enable deletion. ALIGN-L is active at this level, ranked below ONSET to enable resyllabification. This is presented in (9).

 (9) *Stratal OT phrase-level evaluation of vez actriz 'again actress'*

/béh + ak.tríh/	ONSET	*S]CODA	ALIGN-L	IDENT(Pl)	*h	MAX(Seg)
a. \emptyset bé.hak.trí			*		*	*
b. béh.ak.trí	*!				*	
c. béh.ak.tríh	*!				**	
d. bé.hak.tríh			*		**!	
e. bés.ak.trí	*!	*		*		*
f. bé.sak.trí			*	*!		*

In the above tableau, ONSET, the highest-ranked constraint, eliminates fully aligned outputs with empty onset positions (9b, c, e).¹⁷ The return to the 'original' place features with the replacement of input /h/ by output [s] is banned by IDENT(Pl) – the constraint now works in the opposite direction. *h, a segment inventory constraint crucially present in the system, plays a decisive role in choosing the optimal candidate out of the two that tie on ALIGN-L ((9a) and (9d)). Deletion is less costly than aspiration in this case, but only when minimal. The desired output is selected by the grammar, although some comments are in order.

[16] Note that at the word level, each lexical item is evaluated separately. They are not combined until the phrase (post-lexical) component.

[17] There is no evidence for ranking ONSET above *S]CODA or vice versa, hence I leave them unranked. This does not affect any of the evaluations.

Note that the ranking presented in the tableau incorrectly predicts that e.g. word-level /eh.te/ will become *[é.te] at the phrase level, as seen in (1a). Nevertheless, phrase-level [h] deletion only applies word-finally and not word-medially because of high-ranked CONTIGUITY which bans morpheme-internal elision.

Note also that *S]CODA is unviolated at the phrase level. Because the /s/ undergoes aspiration at the word level, *S]CODA is unable to take an active part in candidate evaluation. The segment encountered in the coda at the next level is /h/. The constraint is therefore only active when aspiration is reversed, see (9e). Yet, if *S]CODA is mute, what is the trigger of deletion? It seems that the segment barred from the coda is /h/, otherwise the faithful candidate (which retains input /h/) would surface as optimal. ONSET \gg *h guarantees the retention of /h/ in the onset. Thus, *h ensures the correct evaluation at the phrase level, while *S]CODA is crucial at the word level. Chilean must rank the latter constraint high because only syllable-final /s/ is affected in non-opaque cases. Onset /s/ remains untouched. For instance, *semana* ‘week’, *quise* ‘I wanted’ or *asombroso* ‘astonishing’ cannot have anything else but [s] on the surface.

The above analysis demonstrates that Stratal OT allows for a parallel evaluation of subsequent levels of derivation – the basic assumptions of OT are respected at each level. The distinction between the lexical and post-lexical components is well-grounded and has been widely argued for. The only change required in Stratal OT is minimal constraint reranking to reflect the difference in the phonologies of each of the levels. Therefore, Stratal OT evaluation correctly grasps the fact that /s/ weakening is a phenomenon associated with codas while resyllabification is a phrase-level process with the power to shift prosodic borders but not inhibit word-level phonological changes. Under this approach, treating /s/ aspiration as a coda condition is no longer a mere preconception but a valid conclusion based on the different behaviours of derived and non-derived onsets.

4.2 A note on the stem level

As already mentioned, Stratal OT proposes three levels of phonological operations that legitimise tier-to-tier differences in the treatment of input segments. Meanwhile, the analysis of aspiration-*cum*-deletion in Chilean provides insights not only into the workings of the phonology–syntax interface (i.e. phrase-level processes as opposed to lexical phonology); it also informs us about the important distinction between the stem and the word levels, and about the presence or absence of phonological operations at the level of the stem.

In Chilean, alternations can be observed between singular and plural forms of certain nouns and adjectives, such as *vez* – *veces* [bé] – [bé.se] ‘time(s)’. In this case, the singular form undergoes final coda elision ([bé]), while in the plural, the root-final consonant is syllabified differently (into the onset of the syllable *-es*) and rendered faithfully, without aspiration or deletion ([bé.se]). The plural /s/ ending, being a coda segment, obeys the same rule as the singular *vez*. There are numerous other pairs of this type. Some examples include: *matiz* – *matices* ‘shade(s)’, *mes*

– *meses* ‘month(s)’, *bus* – *buses* ‘bus(es)’, *cortés* – *corteses* ‘polite’, *feliz* – *felices* ‘happy’, etc. These nouns and adjectives all have final stress in the singular and belong to a special group of lexical items that exhibit allomorphy. This is due to the fact that a theme vowel {*e*} either appears on the surface (in the plural) or not (the { \emptyset } allomorph is used). Such allomorph selection applies to stems ending in a vowel, glide or a licit final consonant: /r l n s d/ (Harris 1999).¹⁸ I assume that pluralisation is effected via affixation of the inflectional ending *-s* (Bermúdez-Otero 2006, Bonet, Lloret & Mascaró 2007, but see Colina 2003, 2006 for an opposing view). Since the plural ending never appears inside derivational suffixes (Bermúdez-Otero 2013) and since it is stress-neutral (Den Os & Kager 1986: 43), it must be assigned at the word level.¹⁹ Consequently, aspiration is also word-level. Otherwise the process would overapply in pluralized forms.²⁰ Let us take the word *vez+es* ‘times’ mentioned above. If we assume stem-level debuccalisation, once it is applied to the coda /s/ of the singular stem *vez*, there is no way of reversing the process in the plural *veces*. /s/ aspiration must be therefore activated at the word level and no earlier than that to avoid surface forms such as *veces* [*bé.he].²¹ Thus, constraint reranking must take place in word-level phonology to enable aspiration (faithfulness must be demoted with respect to the coda condition). At the phrase level, another reranking takes place: the MAX(Seg) constraint is demoted to allow deletion and the alignment constraint is demoted to allow resyllabification, as argued in the previous section.

In the next section, I examine the possibilities of dealing with the Chilean data offered by a competing framework: Harmonic Serialism.

5. CHILEAN DATA UNDER HARMONIC SERIALISM

Harmonic Serialism (McCarthy 2008a, 2010b) involves serialism in the sense that derivation takes place in steps, one operation²² at a time. This constitutes a substantial restriction on GEN, with a stepwise evaluation based on a GEN→EVAL→GEN loop that repeats, allowing one operation at each step until

[18] Some examples of words ending in sounds other than /s/ are: *rey/reyes* ‘king’, *marroquí/marroquíes* ‘Moroccan’, *papel/papeles* ‘paper’, *andén/andenes* ‘platform’, or *poder/poderes* ‘power’. The typology of Spanish nouns and adjectives has been investigated by Harris (1994, 1999), Bermúdez-Otero (2006, 2013), Bonet et al. (2007), among others.

[19] I cannot provide a detailed discussion of these issues for reasons of space but see e.g. Bermúdez-Otero (2013) on the behaviour of Spanish affixes attached to roots and stems and their treatment in Stratal OT.

[20] It is worth mentioning that positing aspiration at the word level is against the assumption made by Harris (1983) in rule-based theory, according to which /s/ aspiration is the last cyclic – hence stem-level – rule.

[21] The same applies to other derivatives of Spanish *e*-stems, e.g. diminutives: *voz* [bó] ‘voice’, *voces* [bó.se] ‘voices’, *vocecita* [bo.se.sí.ta] ‘voice’, diminutive.

[22] The term ‘operation’ is somehow problematic. According to McCarthy, Pater & Pruitt (2016: 101), ‘[a]lthough we may speak of HS’s GEN “performing only one operation at a time”, the question of what a single operation can do is an empirical one’. Below, I consider each of the interpretations of the term separately.

convergence, i.e. until the constraint ranking does not trigger any more changes (improvements). Example (10) demonstrates the stepwise approach of Harmonic Serialism (HS).

(10) *HS evaluation of the word vez 'time'*²³

(i) Step 1

/be/	*s]CODA	IDENT(PI)	MAX(Seg)
a. bes	*!		
b. beh		*!	
c. \emptyset be			*

(ii) Step 2

/be/	*s]CODA	DEP(Seg)	IDENT(PI)	MAX(Seg)
a. \emptyset be				
b. beh		*!		

Convergence

In (10i), the candidate with deletion is chosen as optimal as it violates the lowest-ranked constraint of all the candidates. At Step 2, the winner from (10i) becomes the input to (10ii). This time, reverting to *h* or any other sound would be counterproductive as it involves the violation of DEP(Seg) – a constraint militating against insertion. Thus, candidate (10ii.a) emerges as optimal: it does not violate any of the constraints. It is equivalent to the input and hence convergence follows. The derivation is complete. Needless to say, with a more complicated string and more modifications to introduce, there will be a greater number of steps in the derivation. The evaluation process cannot stop until convergence is achieved. Note that inputs change: after each step, the winner becomes the input to another step as a sort of an intermediate form. It inherits all changes and structure acquired at a given stage. Most importantly, no reranking is possible in this framework; gradual harmonic improvement differentiates it from rule-based derivation.²⁴ The evaluation thus mirrors a pre-OT derivation. This seems plausible and similar to rule-based derivations to the extent that no evaluation should be problematic, and the most acute problems encountered by standard OT should be handled flawlessly. Yet precisely because no domain distinctions, ordering or rerankings are allowed, some opacity issues remain unresolved. Moreover, the practical application of the mechanism raises a number of questions.

[23] I omit stress in all HS evaluations given that its application requires additional operations and additional constraints, which would overly increase the number of steps until convergence. Stress is irrelevant for the segmental processes described here and hence its detailed analysis goes beyond the scope of the paper.

[24] This is expressed as two crucial principles governing HS: gradualness (one operation at a time, locality) and harmonic improvement (against the ranking, also local rather than global). See especially McCarthy (2008b).

First, it is unclear whether the mechanism is apt for dealing with systems in which two different strategies are involved in repairing the same marked structure and depend on a structural relation.²⁵ It is not entirely clear whether (re)syllabification is a ‘separate operation’ or an algorithm accompanying other operations with each evaluation in the HS framework. The principle demanding one instance of a phonological ‘modification’ at a time (Prince & Smolensky 1993/2004) that shows harmonic improvement implies that resyllabification, which they assume does not involve faithfulness violations, should not be treated as a separate operation. This, in turn, means that aspiration and resyllabification may be simultaneous at a given stage. Whether it is a blessing or an impediment will be demonstrated shortly. I will present both an evaluation based on this assumption, as well as one contrary to it, i.e. in which resyllabification applies separately.²⁶

Secondly, it is not clear whether a single operation should be understood as applying to one or multiple segments (which may sometimes lead to different outcomes). This is relevant in the case of insertion/deletion processes. In ‘Studying Gen’, McCarthy (2010a: 17) states that ‘if GEN is limited to one instance of an operation at a time’ then we can avoid a situation in which a given operation applies several times at one go to satisfy two high-ranked constraints, e.g. multiple deletion.²⁷ This eliminates iteration, but what if the LOCUS of the operation is different, as in *otra vez actriz* ‘once again actress’? Recent studies of phonological phenomena within the framework of Harmonic Serialism try to determine the exact nature of a ‘single’ change by distinguishing between an instance and a type of change (e.g. Jesney 2008, Pruitt 2008, Elfner 2009, Pater 2010, Kimper 2011; also McCarthy 2008b). Much evidence has been provided for the need to restrict operations in HS to instances of a change and therefore ensuring gradualness (a

[25] In the case of Chilean, resyllabification, which is equivalent to a change in (prosodic) structure interacts with two segmental processes. Note that this involves the ranking of an alignment constraint with respect to a syllable structure constraint (ONSET), whereas HS centers strictly on faithfulness violations.

[26] As noted by a referee, given the fact that mora deletion/insertion does count as a change/modification in HS, a question arises whether mora reassociation would count as a change. If so, re-associating segments across syllables should also be treated as such, otherwise the analysis might entail the abandonment of some prosodic constituents, such as syllables. According to McCarthy (2007: 91–93), feature flop cannot be treated as a single operation in HS as it involves delinking and spreading a feature to another segment. From this perspective, the delinking of a segment from the coda and associating it to the following onset position should also not come ‘for free’. At the same time, however, there have been arguments for treating other prosodic changes, such as tonal shift as a single operation (e.g. Gietz, Jurgel & Percival 2015). Moreover, McCarthy (2016) argues that at least some syllabification operations must be done in parallel with other processes. Thus, it may be that elements from different (prosodic) levels may behave differently and require different treatment in HS. For this reason, I consider two options in the evaluation of the Chilean data under this framework.

[27] Here, reference is made to a hypothetical example *sanata* which surfaces as [san] due to high-ranked Final-C, which requires that words end in consonants, and CODA/son, which requires that codas be sonorants. With low-ranked MAX, deletion is iterated until the desired coda is provided. Such OT typological effects are prevented in HS (see McCarthy 2010a: 17).

crucial tenet of HS) via a distinction between the different loci of phonological operations. This has been dubbed monotonicity.²⁸

Before exploring other possibilities, I first present an evaluation of the Chilean data with two assumptions in mind: single modification as a single instance of an operation and syllabification/resyllabification which goes in parallel with other processes and is COST-FREE. Here, I assume that HS is a strictly faithfulness-based mechanism (following the assumptions provided for another faithfulness-based framework, OT with Candidate Chains (OT-CC), in which the procedure is stated explicitly, see McCarthy 2007).

5.1 Evaluation of the data under Harmonic Serialism as a faithfulness-based framework

With the above considerations in mind, I first present the evaluation of the Chilean data with resyllabification applying cost-free, parallel to segmental operations.

(11) Step 1 evaluation of *vez actriz* ‘time actress’ – one locus at a time

/bes + aktris/	ONSET	*S]CODA	ALIGN-L	IDENT(PI)	MAX(Seg)
a. bes.ak.tri	*!	*			*
b. be.sak.trih			*	*!	
c. be.sak.tris		*!	*		
d. [Ⓢ] be.sak.tri			*		*
e. [Ⓢ] be.hak.tris		*!	*	*	

In (11), the desired candidate, which presents both resyllabification and aspiration of the resyllabified segment applied as one operation, cannot surface as optimal due to an excess violation of *S]CODA. By aspirating and resyllabifying the first coda segment in (11e), we offend a higher-ranked constraint that causes aspiration in the first place. A parallel candidate (11d), on the other hand, obeys the markedness constraint twice by resyllabifying the first /s/ and at the same time getting rid of the second /s/. Obviously, due to the high-ranked ONSET, non-resyllabified candidates will always lose under this ranking. Note that with such an outcome in Step 1 there is no way of getting opaque aspiration later on – this would give a gratuitous violation of IDENT(PI) (no harmonic improvement), which is illustrated in (12) below.

[28] Pruitt (2008: 6) deems prosodic structure assignment in HS monotonic, by adding precisely one foot at a time. This is related to another principle, STRICT INHERITANCE, whereby changes are inherited from preceding steps ‘for subsequent iterations’ and are not ‘undone’.

(12) *Step 2 evaluation locus by locus*

/be.sak.tri/	ONSET	*s]CODA	DEP (Seg)	ALIGN-L	IDENT (PI)	MAX (Seg)
a. [⊖] be.sak.tri				*		
b. be.sak.trih			*!	*		
c. [⊕] be.hak.tri				*	*!	
d. be.ak.tri	*!			*		*

Convergence

In (12) above, each of the candidates presents a change in one locus. The locally optimal output [be.sak.tri] is fed into Step 2 as input. The evaluation provided in (12) shows that the candidate that presents no change with respect to the input is optimal as it violates the smallest number of constraints. Because the Step 2 output is equivalent to the input, convergence takes place and the evaluation is over: no further change can improve on the ranking. Unfortunately, the output generated by HS is non-surface true. The correct output form is [be.hak.tri], yet candidate (12c) incurs an unneeded violation of IDENT(PI) and fails to surface. There is no motivation for aspiration to apply once /s/ is parsed as an onset and therefore ceases to be an illicit segment.

The tableaux in (11) and (12) very well illustrate the fact that filling empty onset positions (if possible) is a priority for the Chilean grammar. No segmental operation would make any of the candidates fare better under this ranking. The only way to get around this problem would be to aspirate at Step 1 with cost-free resyllabification, but there is no motivation for applying aspiration in this particular instance of /s/ instead of repairing the other illicit coda (refer to candidate (11e)).²⁹ Another solution to this conundrum would be to separate aspiration and resyllabification against our original assumption. If we allow resyllabification to apply first, however, the input for aspiration will be equally lost: the proposed constraint ranking will not allow for a different result than a resyllabified candidate. The effect is therefore the same as with resyllabification as a cost-free operation: misaligned outputs are always more harmonic. Resyllabification would have to be somehow delayed, perhaps by some other constraint. This is discussed in Section 5.3. In the next section, I consider the option of incorporating syllabification in HS step-by-step evaluations.

 5.2 *Evaluation of the data under Harmonic Serialism with stepwise prosody*

The process of (re)syllabification is a structure-building operation and therefore does not incur any faithfulness violations, which brings us back to the very interpretation of the HS mechanism as faithfulness-based. A possible path to

[29] This gives us an effect of intrinsic directionality, whereby for the locus to undergo a given operation/repair it is selected by the ranking; the importance of the constraint that is violated by the other loci is left unaffected at a given step. Such an effect is a powerful internal mechanism of consequence for strings consisting of multiple illicit segments.

follow would be to interpret ‘operations’ in HS as not only related to faithfulness (McCarthy 2007), but also encompassing a range of other procedures, such as syllabification or foot assignment, in order to accommodate those processes which are not strictly related to faithfulness constraints and might require the use of a different constraint family (e.g. alignment). Such an approach is adopted e.g. by Elfner (2009) and Pater (2010), who propose syllabification algorithms that accompany other processes in HS evaluations. Indeed, stepwise projection of syllables in accordance with the gradualness principle is a strong case for certain stress-epenthesis interactions in Arabic and the problematic Berber syllabification.

Elfner’s (2009) model includes parsing operations in accordance with two basic principles: core syllable projection (CV syllables) and adjunction (onset/coda) in interaction with constraints mandating parsing. Under such an approach, CV projection will always have priority over attaching e.g. a coda in a given locus (which provides an environment for aspiration or deletion) regardless of the direction in which loci are taken into account in evaluation. The fewer unparsed segments are left in the string the better (fewer PARSESEG violations), unless we are dealing with a language that admits unparsed segments and therefore ranks PARSESEG lower. Complex margins are not projected at one go either. In the string *vez actriz* ‘again actress’, it is quite easy to deduce that the undesired parse $(ve)(sa)kt(ri)z$ will be in place before coda adjunction forces its way through the constraint ranking, as seen in (13).³⁰

(13) *Stepwise CV parse according to Elfner (2009)*

- Input bes + aktris
- Step 1 (be)saktris
- Step 2 (be)(sa)ktris
- Step 3 (be)(sa)kt(ri)s
- Step 4 (be)(sa)k(tri)s
- Step 5 (be)(sak)(tri)s
- Step 6 (be)(sak)(tris)

Pater’s (2010) proposal, on the other hand, includes a segment-by-segment syllabification mechanism, which would not improve on the Chilean data given the onset maximisation principle governing Spanish – onsets are syllabified before codas without exception. See the resultant string in (14). The chief advantage of Pater’s model, however, is its incorporation in the constraint set in the form of

[30] The solution to this problem should be sought in distinguishing between morphological words and delaying syllabification across them. If the two stems are not parsed together up to some moment of the derivation, the analysis could be saved. The same applies to Pater’s proposal. Such an option is provided by Torres-Tamarit (2012), an account which I discuss in the next section.

constraints on syllable formation and sonority instead of an external mechanism mandating syllable projection. It is therefore worth exploring further.

(14) *Stepwise syllable assignment according to Pater (2010)*

- Input bes + aktris
 Step 1 b(e)saktris
 Step 2 b(e)s(a)ktris
 Step 3 b(e)s(a)ktr(i)s
 Step 4 (be)s(a)ktr(i)s
 Step 5 (be)(sa)ktr(i)s
 Step 6 (be)(sa)kt(ri)s
 Step 7 (be)(sa)k(tri)s
 Step 8 (be)(sak)(tri)s
 Step 9 (be)(sak)(tris)

Meanwhile, what the above analysis has shown is that what is needed for the correct evaluation of the Chilean data is a constraint or principle (constraint on GEN perhaps) blocking the syllabification of word-final /s/ in *vez* ‘time/again’ as the onset of *actriz* ‘actress’. Such a constraint would have to refer to morphology or syntax. Note that if the input to the first step in HS is an underlying representation with no prosodic structure whatsoever, there is no syllabification and therefore no resyllabification. There is simply no structure. The structure emerges in candidates as a response to grammar. In such a case, regardless of whether there is syllabic structure in the input or not,³¹ attaching word-final /s/ to the onsetless syllable that follows is the most harmonically improving operation to apply.

Another problem related to the augmented treatment of operations in HS as not necessarily involving only faithfulness violations is that the violation count itself may become problematic. Note that structure-building processes project constituents that consist of more than one unit (segment or subsegment). For instance, Elfner’s (2009) syllabification algorithm projects a whole CV syllable at once while it parses margins one at a time. Pruitt’s (2008) foot assignment creates a whole foot, which can be either mono- or bisyllabic and already contains a head, incurring violations of several constraints at once. At the same time, segmental processes do not escape this new rule – Elfner’s epenthesis in Arabic inserts a vowel and two moras at one go: one on the epenthetic vowel and one on the resultant coda consonant to satisfy the weight-by-position rule. A short illustration of the latter case is provided here for convenience:

[31] We might assume that the input string consists of syllabified words, but we would then be given individual word outputs with word-final deletion. There would be no way of restoring the lost segment by epenthesis or other means that would be justified by the Spanish grammar.

(15) *Evaluation of the word /katab-t-l-ha/ ‘I wrote to her’. Step 7: Epenthesis*

Input to Step 7:	(ka)(tab)(tl)(ha)	PARSESEG	SYLL-HEAD	PARSE σ	DEPV	NOCODA
epenthesis	\varnothing a. (ka)(tab)(t _i μ _l)(ha)			****	*	**
stress	b. (ka)[(táb)](tl)(ha)		*!	***		*
no change	c. (ka)(tab)(tl)(ha)		*!	****		*

(adapted from Elfner 2009: 32)

In (15), candidate (15a) shows vowel insertion, which triggers moraicity in the now coda consonant (*l*). There are no violations of MAX μ , however, despite the fact that two moras have been inserted. This is because Elfner (2009: fn. 26) assumes that mora insertion is not a separate operation in HS. Such a treatment of faithfulness constraint violations raises questions concerning the gradualness principle and its limitations.

To summarise, although a faithfulness-only evaluation mechanism is more straightforward and transparent in what counts as a single operation across processes and languages (and ensures derivation by small incremental steps against the ranking), several studies have shown that there is a need for an appropriate treatment of structure building in OT. The prosodic systems presented in this subsection are the most satisfying to date, but the problems they raise point to the need for a constructive debate on the subject, and for the refinement of the proposed frameworks.

5.3 *Evaluation of the data under Harmonic Serialism with serial prosodic parsing*

In view of the above, it is worth looking at one recent attempt at dealing with certain opacity effects in HS by invoking prosodic parsing. Torres-Tamarit (2012, 2014) defends the idea that prosodic structure should be built in steps and that prosodic constituents create opaque domains in phonology. Crucially, core syllabification should be applied in each morph separately. To prevent the projection of a core syllable (filling onsets, CV) across a prosodic domain in phrase-level phonology, he makes use of two alignment constraints: ALIGN-L(stem, Prosodic Word) and ALIGN-L(Morphological Word, Prosodic Word).³² The two constraints partially overlap. After all, a morphological word is a stem as well, but, crucially, the two are needed to account for opaque overapplication in a series of Spanish dialects showing aspiration, but not deletion. Torres-Tamarit assumes that morphology precedes phonology by arranging roots and affixes hierarchically. Stems are built successively in this model, the end result of which is the Morphological Word, ‘the linguistic unit of analysis whose integrating parts are unable to be manipulated by syntax’ (Torres-Tamarit 2012: 118).

[32] ALIGN-L(stem, PWD): the left edge of every stem must coincide with the left edge of some prosodic word (McCarthy & Prince 1993). ALIGN-L(MWD, PWD): the left edge of every morphological word must coincide with the left edge of some prosodic word (Selkirk 1995).

Stems and Morphological Words (MWd) are treated differently by phonology. Thus, the word *vez* ‘time’ can be represented as [[[vez_{Root}]∅]_{Stem}]_{MWd}, while the plural *veces* ‘times’, as [[[[vez_{Root}]e]_{Stem}]_s]_{MWd}. The morphosyntax–prosody mapping is enforced by two types of constraints: alignment and parsing. The latter set consists of PARSE-SEGMENT, which penalises segments that are not associated with a syllable, and PARSE-PROSODICWORD, which mandates that each prosodic word be associated with a phonological phrase (Torres-Tamarit 2012: 119). These constraints are in interaction with the coda condition banning /s/ at the right syllable margin and the constraint mandating place identity between the input and the output. In the course of the derivation, the relative ranking of alignment and parse constraints is responsible for the different orders of prosodic structure assignment and allows for prevocalic /s/ debuccalisation in opaque contexts. Torres-Tamarit illustrates this with an example of a prefixed word in which overapplication takes place across a prefix boundary, similarly to phrase-level overapplication in Chilean.³³ The word *des-armar* [de.har.már] ‘to disarm’ requires the following constraint hierarchy: ALIGN-L(STEM, PWD) ≫ PARSE-SEG ≫ ONSET ≫ *S]CODA ≫ ALIGN-L(MWD, PWD) ≫ PARSE(PWD). The derivation of the word *desarmar*, as produced in a non-Chilean variety of Spanish, with opaque aspiration across a word and prefix boundary, but no deletion, is presented in (16). Levels of prosodic structure are marked as follows: parentheses are used to mark syllable parsing, square brackets mark prosodic words, and braces mark phonological phrases.

(16) *HS derivation of the word desarmar ‘to disarm’ as produced in non-Chilean Spanish*

(i) Step 1

/des+am+ar/	ALIGN-L (STEM, PWD)	PARSE- SEG ³⁴	ONSET	*S]CODA	ALIGN-L (MWD, PWD)	PARSE (PWD)
a. σ des[amar]		8			*	*
b. (de)(sar)(mar)	*!				*	
c. desarmar	*!	8			*	
d. [desarmar]	*!	8				*
e. {desarmar}	*!	8			*	

(ii) Step 2

/des[amar]/	ALIGN-L (STEM, PWD)	PARSE- SEG	ONSET	*S]CODA	ALIGN-L (MWD, PWD)	PARSE (PWD)
a. σ (des)(ar)(mar)			*	*	*	*
b. des[amar]		8!			*	*
c. [des[amar]]		8!				*
d. {des[amar]}		8!			*	

[33] The only difference between the two is that the prefix does not have the status of a prosodic word. Instead, it is incorporated into a nested PW, whereas in sequences of words both stems are parsed as PWs. In Torres-Tamarit’s analysis the same ranking derives opaque aspiration in both cases.

[34] Here, the number of segments which are not attached to any syllable node is counted.

(iii) Step 3

/[(des)[(ar)(mar)]/	ONSET	*S]CODA	ALIGN-L (MWD, PWD)	PARSE(PWD)	IDENT(PI)
a. \varnothing [(deh)[(ar)(mar)]	*		*	*	*
b. [(des)[(ar)(mar)]]	*	*!		**	
c. (des)[(ar)(mar)]	*	*!	*	*	
d. {(des)[(ar)(mar)]}	*	*!	*		

(iv) Step 4

/[(deh)[(ar)(mar)]/	ONSET	*S]CODA	ALIGN-L (MWD, PWD)	PARSE(PWD)
a. \varnothing [(deh)[(ar)(mar)]]	*			**
b. (deh)[(ar)(mar)]	*		*!	*
c. {(deh)[(ar)(mar)]}	*		*!	*

(v) Step 5

/[(deh)[(ar)(mar)]/	ALIGN-L (STEM, PWD)	ONSET	ALIGN-L (MWD, PWD)	PARSE(PWD)
a. \varnothing [(de)[(har)(mar)]	(*)			**
b. [(deh)[(ar)(mar)]		*	*!	**
c. {(deh)[(ar)(mar)]}		*	*!	

(adapted from Torres-Tamarit 2012: 120–122)

As seen in (16), the derivation of the word *desarmar* [de.har.már] ‘to disarm’ requires five steps. At Step 1, the stem is parsed into a prosodic word given the high ranking of the constraint ALIGN-L(STEM, PWD). At Step 2, PARSE-SEG drives syllable projection. At Step 3, high-ranked *S]CODA mandates coda /s/ debuccalisation. This is followed by further parsing into prosodic words: this time the whole morphological word, including the prefix, is parsed. At the next step, the debuccalised segment is parsed into the following syllable regardless of the prosodic word boundary. This, however, is possible only with a reformulation of the ALIGN-L(STEM, PWD) constraint, which must be active only if there are no input syllables. In other words, candidate (16.v.a) in Step 5 does not violate the alignment constraint because syllable structure was already there. Without this reformulation, the correct output would be impossible to generate given the high ranking of the constraint (this is marked with a violation mark in parentheses in the tableau). Thus, with a stepwise approach and a modification of alignment, HS is able to derive words with opaque aspiration across a prosodic word boundary.

Let us now take a look at a similar derivation of the Chilean case in (17).

(17) *HS derivation of the sequence vez actriz ‘again actress’ as produced in the Chilean dialect*³⁵

(i) Step 1

/bes#aktris/	ALIGN-L (STEM, PWD)	PARSE-SEG	ALIGN-L (MWD, PWD)	PARSE(PWD)
a. \varnothing [bes]#[aktris]		9		**
b. (bes)#(ak)(tris)	**!		**	
c. bes#aktris	**!	9	**	
d. {bes#aktris}	**!	9	**	
e. bes#[aktris]	*!	9	*	*

(ii) Step 2

/[bes]#[aktris]/	ALIGN-L (STEM, PWD)	PARSE-SEG	ONSET	*S]CODA	PARSE(PWD)
a. \varnothing [(bes)]#[(ak)(tris)]			*	**	**
b. [bes]#[aktris]		9!			**
c. {[bes]#[aktris]}		9!			*

(iii) Step 3

/[(bes)]#[(ak)(tris)]/	ONSET	*S]CODA	PARSE(PWD)	IDENT(PI)	MAX(Seg)
a. [(beh)]#[(ak)(tris)]	*	*	**	*!	
b. [(bes)]#[(ak)(tris)]	*	**!	**		
c. {[(bes)]#[(ak)(tris)]}	*	**!			
d. \varnothing [(bes)]#[(ak)(tri)]	*	*	**		*
e. [(bes)]#[(ak)(trih)]	*	*	**	*!	
f. \varnothing [(be)]#[(ak)(tris)]	*	*	**		*

As illustrated in (17), when deletion is available as a second repair strategy, the correct forms cannot be generated, hence the Chilean case cannot be solved in HS with the proposed ranking. As argued in the previous sections, MAX(Seg) must be ranked below IDENT(PI) to enable deletion instead of aspiration before a consonant or a pause. As we are dealing with phrase phonology here, the two words taken from the sequence *vez actriz* ‘again actress’ must be parsed into prosodic words separately and only then prosodified further into a phonological phrase to enable resyllabification. Thus, syllabification is blocked in Steps 1–3.

In (17), the sequence *vez actriz* is first parsed into prosodic words due to the high-ranked ALIGN-L(STEM, PWD). The symbol # is used to mark the morphological boundary between words. At Step 2, the two words are syllabified separately, in accordance with the ranking (high position of PARSE-SEG in the hierarchy). This is in line with Torres-Tamarit’s evaluation of word- and phrase-level overapplication presented above. Step 3 presents a deviation. Note that because deletion is a permitted strategy in Chilean, MAX(Seg) has to be ranked

[35] Note that ONSET and *S]CODA are ranked in Torres-Tamarit’s account. I preserve this ranking in the tableaux that follow as they are based on Torres-Tamarit (2012). The two constraints, however, may as well be left unranked, as in the Stratal OT analysis presented above, as they do not interact in the evaluations shown throughout the paper.

low. Yet with this ranking, aspiration will always be suboptimal compared to segment deletion as it incurs a violation of a higher-ranked constraint. Thus, aspiration cannot be generated at this Step. The high-ranked *S]CODA constraint mandates some kind of a repair, but deletion is a better option against the ranking, and resyllabification is banned. Thus, candidate (17.iii.a) loses with the more harmonic (17.iii.d) and (17.iii.f). What is more, two segments violate the coda condition against /s/ so either of them may be repaired first. Were the loci to be combined, i.e. processes to apply to all loci simultaneously, the situation would be equally unresolved. Note that the two words of the sequence *vez actriz* are parsed separately and hence are equally good candidates for deletion.³⁶ Meanwhile, the deletion of the second /s/ is in line with the attested pattern, but the /s/ of the word [(bes)] cannot be lost because there is no way of restoring it at a later stage. The two words are not prosodically combined into a phonological phrase and are therefore evaluated separately, as stand-alone items. The best option at this step would be to parse the two words together, but this requires a different ranking of the constraint PARSE(PWD). Because all candidates tie on the highest-ranked constraint (ONSET), and the winners are determined by the satisfaction of *S]CODA, PARSE(PWD) would have to be ranked above the latter constraint to render (17.iii.c) optimal.

Such a ranking is well-suited for dialects in which /s/ aspiration only applies transparently (Torres-Tamarit 2012: 124), however. This prediction is borne out when analysing the Chilean data as well. If the two crucial constraints are reranked, candidate (17.iii.c) is locally optimal at Step 3, but then the original problem reappears: when the two words are parsed together and resyllabification is enabled, it will always be a better option than aspiration because it allows for satisfying high-ranked ONSET without an additional violation of IDENT. This is illustrated in (18).

[36] The Chilean data demonstrate that evaluation has to be effected locus by locus. Otherwise we would be dealing with a pathology (McCarthy 2011). Because /s/ is not deleted word-internally due to high-ranking CONTIGUITY, an input with multiple loci including word-internal position gives aspiration at Step 3, e.g. *estas aguas* [(eh.tah)]#[(a)(gwah)] ‘these waters’, whereas an input such as *vez actriz* analysed above shows deletion instead of aspiration: [(be)]#[(ak)(tri)] if we applied each process simultaneously in all loci. Needless to say, the end result will be different for each of these inputs: the grammar gives a pathological prediction. For details, see Broś (2016).

(18) Step 4 evaluation of the input $\{[(bes)]\#[(ak)(tris)]\}$ with $PARSE(PWD) \gg *S]CODA$ ³⁷

$\{[(bes)]\#[(ak)(tris)]\}/$	ONSET	*S]CODA	ALIGN-L (MWD, PWD)	IDENT(PI)	MAX(Seg)
a. $\{[(bes)]\#[(ak)(tris)]\}$	*!	**			
b. $\{[(be)]\#[(sak)(tris)]\}$		*	*		
c. $\{[(beh)]\#[(ak)(tris)]\}$	*!	*		*	
d. $\{[(be)]\#[(ak)(tris)]\}$	*!	*			*
e. $\{[(bes)]\#[(ak)(tri)]\}$	*!	*			*

To conclude, it has been demonstrated that HS is unable to account for the Chilean data as long as it cannot independently block resyllabification from applying. There is no way of aspirating coda /s/ once it is syllabified as an onset because any operation on an onset /s/ would automatically predict that all Chilean /s/ segments, be it word-initial or word-medial ($[s]emana$ ‘week’, $al[s]a$ ‘growth’, $co[s]a$ ‘thing’), as well as syllable- and word-final ($esto$ ‘this’, $cosas$ ‘things’), are marked and undergo weakening, which is contrary to the reported data. Non-resyllabified onset /s/ is free from modification in this dialect and can be considered strong. At the same time, the analysis of a whole string consisting of more than one word leads to confusion between non-resyllabified and resyllabified onsets under HS. This obstacle can be overcome to some extent with the addition of prosodification and hierarchical morphological structure that distinguishes between morphs. As argued by Torres-Tamarit, step-by-step prosodic parsing in interaction with the (mis)alignment of morphological and prosodic constituents is able to generate several types of dialectal variation, both with and without opaque process application. Nevertheless, this prediction is not borne out in the case of Chilean, which permits two types of repairs. Whenever a more invasive process is permitted by the ranking, it is enabled because it violates a lower-ranked constraint than the competing, less invasive process. This means that the former will always be more harmonic in a parallel evaluation in which no reranking is allowed. Thus, step-by-step prosodic structure building incorporated in a parallel, operation-by-operation evaluation is insufficient to account for such complicated data.

5.4 Evaluation of the data under Harmonic Serialism with stepwise deletion

There is yet another way the data could be analysed in HS. As argued by McCarthy (2008b), in Harmonic Serialism, deletion should be treated as a gradient process in the sense that it cannot happen in one step. First, debuccalisation applies to the illicit segment, and only then can it be deleted at a subsequent stage. This requires a reformulation of some faithfulness constraints. In this paper, I assume that features are attributes of segments rather than separate entities, hence

[37] This ranking makes sure that the two words are parsed together into a phonological phrase at Step 3, hence the input to Step 4 in (18) is $\{[(bes)]\#[(ak)(tris)]\}/$.

I use IDENT(PI) rather than MAX(PI). If the laryngeal node is considered to be a separate entity, however, MAX(PI) should be used and violated whenever a segment is deleted. Thus, deletion implies two unfaithful operations in HS with MAX(PI) in place. Consequently, if complete deletion is impossible (= blocked) at Step 3, then the correct output of *vez actriz* ‘again actress’ can be generated (see Tableau (19vi) below).

(19) *Steps 3–8 under HS with stepwise deletion*

(i) Step 3

/[(bes)]#[(ak)(tris)]/	ONSET	*s]CODA	PARSE(PWD)	MAX(PI)	MAX(Seg)
a. [(bes)]#[(ak)(tris)]	*	***!	**		
b. \emptyset [(beh)]#[(ak)(tris)]	*	*	**	*	
c. {[(bes)]#[(ak)(tris)]}	*	***!			
d. \emptyset [(bes)]#[(ak)(trih)]	*	*	**	*	

(ii) Step 4

/[(beh)]#[(ak)(tris)]/	ONSET	*s]CODA	PARSE(PWD)	MAX(PI)	MAX(Seg)
a. [(beh)]#[(ak)(tris)]	*	*!	**		
b. \emptyset [(beh)]#[(ak)(trih)]	*		**	*	
c. {[(bes)]#[(ak)(tris)]}	*	*!			

(iii) Step 5

/[(beh)]#[(ak)(trih)]/	ONSET	*s]CODA	PARSE(PWD)	MAX(PI)	MAX(Seg)
a. [(beh)]#[(ak)(trih)]	*		***!		
b. \emptyset {[(beh)]#[(ak)(trih)]}	*				
c. [(beh)]#[(ak)(tri)]	*		***!		*
d. [(be)]#[(ak)(trih)]	*		***!		*

(iv) Step 6

/[{[(beh)]#[(ak)(trih)]]}/	ONSET	*s]CODA	PARSE(PWD)	MAX(PI)	MAX(Seg)
a. {[(beh)]#[(ak)(trih)]}	*!				
b. \emptyset {[(be)]#[(hak)(trih)]}					
c. {[(beh)]#[(ak)(tri)]}	*!				*

(v) Step 7

/[{[(be)]#[(hak)(trih)]]}/	ONSET	*s]CODA	HAVEPLACE	MAX(PI)	MAX(Seg)
a. {[(be)]#[(hak)(trih)]}			***!		
b. \emptyset {[(be)]#[(hak)(tri)]}			*		*
c. {[(be)]#[(ak)(trih)]}	*!		*		*

(vi) Step 8

/[{[(be)]#[(hak)(tri)]]}/	ONSET	*s]CODA	HAVEPLACE	MAX(PI)	MAX(Seg)
a. \emptyset {[(be)]#[(hak)(tri)]}			*		
b. {[(be)]#[(ak)(tri)]}	*!				*

Convergence

As illustrated in (19), place features are deleted first (Steps 3–4), then the two words are combined into a phonological phrase to satisfy the highest-ranked constraint after *s]CODA (Step 5), which means that resyllabification can take place at Step 6. Then, to minimise the number of placeless segments (mandated by HAVEPLACE), word-final non-resyllabified [h] is deleted.

Unfortunately, this solution encounters a problem. In Chilean, prefixed words behave differently than sequences of words: there is no aspiration across a prefix boundary (e.g. *des+armar* ‘disarm’ surfaces as [de.sar.már]). Under HS with prosodic phrasing presented above, there is no way of distinguishing between the two types of input strings and preventing aspiration at Step 3, however. The output of *desarmar* with McCarthy’s double-step solution will inevitably be [de.har.már], which is unattested – see (20).³⁸

(20) *Step 3 evaluation of the word desarmar ‘to disarm’ under HS with stepwise deletion*

/[(des)]#[(ar)(mar)]/	ONSET	*s]CODA	PARSE(PWD)	MAX(PI)	MAX(Seg)
a. [(des)]#[(ar)(mar)]	*	*!	*		
b. [⊗] [(deh)]#[(ar)(mar)]	*		*	*	
c. [⊗] {[(des)]#[(ar)(mar)]}	*	*!			

Stratal OT, in turn, does not have a problem with prefixes in Chilean. The issue is resolved at the word level, as is seen in (21).

(21) *Stratal OT analysis of desarmar ‘to disarm’ (word level)*

/des + armar/	ONSET	*s]CODA	ALIGN-L	MAX(Seg)	IDENT(PL)	*h
a. [des.[ar.már]]	*!	*				
b. [de.[ar.már]]	*!			*		
c. [deh.[ar.már]]	*!					*
d. [⊗] [de.[sar.már]]			*			
e. [de.[har.már]]			*		*!	*

In view of the above evaluations couched in the Harmonic Serialism framework, the superiority of Stratal OT lies in the fact that its very design assumes serial prosodic structure building associated with morphophonological strata, and each stratum is based on different phonological predictions, hence a different ranking. As for HS, for the time being, it seems that it is unable to grasp the distinction between the word and the phrase levels in an appropriate way. Crucially for the opacity case presented here, the phrase level is the domain in which resyllabification comes into play. It is the key to explaining the non-uniformity of the different onset positions (with or without an intervening word boundary) in phonology and the opaque application of one of the *s]CODA repairs. The repair chosen at a given time depends on the domain of application

[38] Unlike in other Spanish varieties, e.g. in the dialects referred to by Torres-Tamarit (2012), including the Granada dialect. The latter was also analysed by Broś (2018) in an interdialectal comparison of prefix treatment in Spanish.

(word, phrase). Deletion applies at the phrase level and can be prevented in smaller domains e.g. by means of contiguity (morpheme contiguity inside words or even prosodic word contiguity in the case of prefixed words, see Broś 2018).

6. OUTSTANDING ISSUES

In this section, I discuss alternative approaches and phonetic considerations related to the analyses presented in the paper.

6.1 *Output-Output faithfulness*

At first sight, it might seem that an output–output (OO) relation would solve the presented opacity problem. Such a solution was proposed e.g. by Kenstowicz (1996) and Colina (1997, 2002) for Spanish dialects presenting aspiration only. Note, however, that Benua’s (1995, 1997) Transderivational Identity or any other OO model would be unsuitable in the case of the Chilean data as output identity is exactly what we DO NOT want to achieve: Chilean /s/ final words are not at all uniform in their surface structure, presenting either [s] or [h], or otherwise deletion (compare *vez* ‘time’ [béØ] in the singular, [bé.se] in the plural and [ó.tra.βé.hak.trí] across a word boundary before a vowel). OO Identity would be counterproductive in this case.

6.2 *Prosodic domain constraints and the ‘lifecycle of phonological processes’*

Flack’s (2009) proposal concerning the distinction of various prosodic domains in phonology in the form of constraints related to these particular domains might be entertained as an alternative. For instance, a constraint banning /h/ at the edge of a phonological phrase (*h]PPh) might be used to ensure that deletion occurs phrase-finally. Note, however, that deletion is also encountered at the end of a word before a word starting with a consonant and hence the environment for deletion is not uniform (word-final /s/ → [h] before a vowel is resyllabified). Although this may be interpreted as ‘saving’ the illicit /h/ from deletion, an important generalisation escapes. Rather, the Chilean data should be considered evidence for the narrowing of phonological domains of process application in the sense of Bermúdez-Otero’s (2007b, 2015) proposal. According to this hypothesis, phonological processes start from the broadest domains and, with time, undergo domain narrowing from the phrase level, through the word level, to the stem level, to be finally lexicalised. Thus, /s/ aspiration was initially a phrase-level process (as in other Spanish dialects and historically), and has been narrowed down to the word level, where it applies extensively. This resulted in a partial loss of contrast on the surface, and in possible changes in the underlying representations (note e.g. the lack of alternations in morpheme-internal position). Chilean perfectly illustrates Bermúdez-Otero’s ‘life cycle of phonological processes’ in that coda /s/ aspiration started with phrase-final contexts, to be then extended to word-final and word-medial positions. This is in line with Lipski’s (1999: 198) diagnosis of coda

/s/ behaviour across dialects: ‘s weakens to *h* in preconsonantal contexts [...]; (at the second stage, syllable-final *s* reduction extends to all syllable-final contexts, including phrase-final ... while retaining word-final prevocalic *s*. [T]he extension to include word-final prevocalic *s* occurs in the phonologically most advanced dialects’. At the same time, the emergent process of deletion starts from the outer domains: so far, it does not interfere with morpheme integrity and does not go beyond word-final coda position (sparing derived onsets). Presumably, however, as another step in the ongoing sound change, deletion will extend to all other positions.

6.3 *The phonetics and phonology of resyllabification*

Given the fact that resyllabification is central to the analysis of the Chilean data, a brief discussion of the reasoning behind the treatment of this process as active in Chilean is due at this point. The traditional approach to Spanish syllabification has been to describe it as a readjustment strategy at the word level. This means that whenever two syllabified words are put together by syntax and the second one begins with a vowel, the generalised principle of onset maximisation drives resyllabification: the coda of the first word is incorporated into the following syllable to form an unmarked CV structure. Such an approach, taken e.g. by Harris (1969, 1983), Hualde (1991), Colina (1997, 2006, 2009), Kaisse (1999), Face (2002), Bermúdez-Otero (2011) or Ramsammy (2013), was largely uncontroversial until recently. The existence of the process is confirmed both by speaker intuitions³⁹ and by phonological operations: resyllabification blocks aspiration in some Spanish dialects (see e.g. Kaisse 1999, Wiltshire 2002, and Torres-Tamarit 2012 for an overview). Besides, optional emphatic trilling has been reported in word-final rhotics that never occurs in resyllabified onsets (Harris 1983).⁴⁰ Nevertheless, given that some opacity effects (such as the one described here for Chilean, /s/ voicing in Quito Spanish, Strycharczuk et al. 2014, or nasal velarisation, Ramsammy 2013) ensue due to resyllabification, some doubt has been cast on whether the process actually takes place.

Hualde & Prieto (2014), for instance, report that the duration of /s/ in onsets derived by resyllabification is shorter than in canonical word-initial and word-medial onsets. Following up on this study, Strycharczuk & Kohlberger (2016) report that the duration of /s/ in derived onsets is intermediate between the duration of canonical onsets and the duration of canonical codas in a non-aspirating

[39] See Hualde (1991) and Cardinaletti & Repetti (2009) for statements on speaker intuitions, as well as Lleó (2013) and references therein for intuitive acquisition of resyllabification by Spanish monolingual natives contrasted with Spanish–German bilinguals living in Germany.

[40] It is not clear whether emphatic trilling applies to the dialect studied here. There are no empirical studies addressing this phenomenon. According to Lenz, Bello & Oroz (1940), the pronunciation of /r/ varies across contexts and speakers, as well as styles. They mention devoicing and fricativisation of the /r/, but also full voicing and vibration before consonants and at the end of a word in ‘educated’ speech of the higher social classes.

Peninsular variety of Spanish, hence we can talk of partial resyllabification only. Whether the same can be said about the dialect analysed here requires further research. It must be noted, however, that the above phonetic studies take only /s/ and no other consonants into account in determining the status of resyllabification. Besides, they were conducted in controlled settings with elicited speech, whereas resyllabification is a connected, spontaneous speech process.⁴¹ Needless to say, the determination of whether full resyllabification takes place or not is rendered extremely difficult in aspirating dialects, in which the segment to be compared between the coda and the onset position changes its phonetic status ([s – h]).⁴² Thirdly, the studies countering the resyllabification hypothesis rest on the assumption that if resyllabification is assumed to take place, then the duration of derived onsets must be the same as mean durations of canonical, non-derived onsets in the language. Otherwise resyllabification cannot be treated as a categorical phonological process. It may be, however, that duration is not the only (or the relevant) phonetic information concerning syllable structure. Besides, it has been shown in a number of studies on speech production and perception that subphonemic (hence non-categorical) differences can be both perceived and produced by speakers, but not necessarily have any influence on categorical phonological processes.⁴³

Syllables are both psychological and functional units. They also serve as theoretical devices explaining phonological phenomena, and while their internal structure and parsing into higher prosodic constituents are debatable, their very existence is difficult to refute.⁴⁴ In morphophonological terms, derived syllables can be treated as completely resyllabified and at the same time different from canonical syllables (e.g. in segmental duration) given the morphology–phonology mismatch in the form of an intervening morphological word boundary (e.g. [la.s|a.las] as opposed to *la sala* [la.sa.la] ‘the room’).⁴⁵ This is due to the fact that morphology and phonology are closely interrelated and that syllabification in general is fed by morphology (more specifically, by the concatenation of morphemes). Otherwise, phonetic differences of the type reported by Strycharczuk & Kohlberger could also be analysed, as the authors themselves suggested, in terms

[41] Harris (1983) deems the process obligatory and natural in casual speech. Un-resyllabified word sequences are hypercorrect under his analysis (p. 57).

[42] As noted by a referee, a study might be designed that compares coda [h] to resyllabified [h]. This would give us insight into the differences in length of the two positions. Nevertheless, note that Strycharczuk & Kohlberger (2016) focused on the difference between a canonical and derived onset, a study design which cannot be replicated with [h].

[43] See e.g. works on the perception of neutralised obstruents in Polish, Słowiaczek & Szymańska (1989), or near-neutralisation and lengthening of pre-voiced obstruent vowels in German, Port & O’Dell (1985), but confer Van Oostendorp (2008).

[44] Although this has been taken up in literature by some scholars. See Côté (2012) for an overview; see Treiman & Kessler (1995), Rubach (1999), Zec (2007) and others in defence of the syllable.

[45] The morphological mismatch hypothesis is entertained e.g. by Colina (2006). Note, however, that such an approach implies morphologically-conditioned phonetics, which is ruled out by many versions of Stratal OT, especially the one promoted in this paper. I would like to thank an anonymous referee for pointing this out to me.

of prosodic misalignment whereby prosodic word boundaries are misaligned with syllable structure ([[la.s]_{PW}[a.las]_{PW}]). Such an interpretation of prosodic structure in Romance languages has also been proposed by Cardinaletti & Repetti (2009). Thus, a systematic difference between different types of syllables (with derived vs. canonical onsets) can be drawn.

Lipski (1999) proposes an analysis of /s/ aspiration in terms of ambisyllabicity. He argues that cases of misalignment between the word and the prosodic structure before stressed syllables are extremely rare, which supports Kahn's (1976) general principle that there is no ambisyllabicity before stressed vowels. Chilean defies this generalisation, however. Here, aspiration before vowels is a generalised process independent of stress. The concept of ambisyllabicity is not uncontroversial and has been subject to polemic many times over (see e.g. Jensen 2000 and Bermúdez-Otero 2007a for an account of ambisyllabicity paradoxes; also Selkirk 1982, Harris 1999, and others). Meanwhile, Lipski's analysis requires a revised definition of alignment constraints which are not to be violated by ambisyllabic segments. If this is to be followed, other cases, such as deletion blocking in other consonantal contexts would still be problematic as the MAX(Seg) constraint has to be ranked low. Besides, he posits ambisyllabicity for some varieties of Spanish only and there seem to be no other phonological processes that support his hypothesis.⁴⁶ Moreover, Strycharczuk & Kohlberger (2016) argue that the treatment of word-final segments as ambisyllabic does not necessarily explain durational differences and may be incompatible with the behaviour of Spanish fake geminates.

A thorough discussion of the above possibilities requires further research (especially experimental data concerning the Chilean dialect), and therefore goes beyond the scope of this paper. In my analysis of Chilean, I took the traditional approach to Spanish syllabification, following Harris (1983) and others, and based on a series of empirical observations made during my fieldwork.

First, Chilean speakers typically present no phonetic features that might suggest lack of resyllabification: in my data, syllable to syllable transitions across words are very smooth, there are no glottal stop insertions or any other sounds or boundaries intervening except for intonational pauses (emphasis, hesitation, clarification). The latter phenomenon seems to confirm Mathews' (1994) claim that resyllabification applies only up to the end of an intonational phrase. Given the fact that intonational peaks vary depending on the employed pauses and information put in focus (Quilis 1993), prominence undergoes changes whenever intonational boundaries are restructured, which may be of consequence for phonological processes (see also Nespor & Vogel 1986: 212).⁴⁷

[46] One study by Amastae (1986) uses double linking to explain spirantisation, but this would require the existence of ambisyllabic branching codas and Spanish bans branching codas with the exception of some cases abiding by the Sonority Sequencing Generalisation (SSG).

[47] This is precisely what I have observed in Chilean. When an intonational phrase is shortened by a pause (e.g. for emphasis), underlying /s/ appears on the surface, although this effect is not

Other facts suggesting that resyllabification should be embraced in analysing Chilean include lack of /r/ devoicing in derived onsets as opposed to final codas (see Lipski 1996), and consonant deletion blocking across a word boundary in words such as *ciudad* ‘town’ or *cantidad* [kan.ti.ðá] ‘number’ vs. *cantidad importante* [kan.ti.ðá.ðim.por.tán.te] ‘significant number’. Given that coda obstruents are banned in Chilean and deletion is an attested process, there is no other explanation for the non-deletion of a word-final coda than resyllabification (word-medial codas are saved by a constraint mandating morpheme contiguity). Needless to say, the same argument can be posed in the case of aspirated word-final /s/ before a vowel (2b). If it were not for resyllabification, we would expect the /s/ to delete, as in (1b) or (2a).⁴⁸

Another fact worth bringing to the reader’s attention concerns vowel merger and gliding. Both processes can be encountered at word boundaries. They are driven by ONSET, and possibly also by *V.V, a constraint banning vowel hiatus.⁴⁹ Thus, in such phrases as *quiere estar* ‘(s)he wants to be’, *para ambos* ‘for both’ or *que entre en* ‘so that (s)he enters in’, the two identical vowels merge into one short or long vowel: [cje.reh.tár], [pa.rá:m.bo], [cé:n.tren]. The lengthening is obligatory when the second vowel is stressed. When the vowels in contact are of different qualities, gliding occurs and the syllables are restructured across word boundaries: *la cosa que hay* [la.kó.sa.çéáj] ‘the thing that is’, *este acontecimiento* [éh.tə.kon.te.si.mjén.to] ‘this event’.⁵⁰ Furthermore, vowel deletion can take place in fast speech, resulting in resyllabification: *una fuerza importante* [u.na.fwér.sim.por.tán.te] ‘a significant force’.⁵¹ Thus, various types of repairs are attested in this language at word junctures which seem to be at least partially driven by the same constraint as resyllabification alone (independently of segmental processes), namely ONSET.

7. GENERAL CONCLUSIONS

As demonstrated in this paper, there is strong evidence for the need to include derivations in OT. The data provided here for illustration are just a sample of the material put forward by many phonologists in recent years to lend support to this claim. The paper attempted to show how closely morphology and phonology are

systematic and needs to be further studied. In very short pauses before vowels, e.g., /s/ is most often debuccalised, which confirms the fact that aspiration affects codas and is followed by resyllabification. What’s more, sometimes a pause takes place before the debuccalised segment.

[48] I would like to thank Janina Molczanow for pointing this out to me.

[49] Note that *V.V cannot be ranked too high, given that vowel hiatus is attested in Spanish inside words and across word boundaries in careful speech (e.g. *espía* ‘a spy’, *actuar* ‘to act’, *poesía* ‘poetry’, *idea* ‘idea’, etc.).

[50] See an overview of vowel contact and diphthongisation by Colina (2009).

[51] Note that the phenomena described in this section are centred on the Chilean variety analysed in this paper and may, but do not necessarily coincide with other varieties of Spanish. Unless stated otherwise, the above observations concerning word junctures, including vowel hiatus, are based on my corpus of Chilean Spanish.

tied together. Phonological operations are strictly dependent on the underlying word structures and on the concatenation of morphemes. At the same time, prosodic structure building is an important part of grammar. Prosody–morphology misalignment is of consequence for phonology given that opacity is observed at morpheme edges in word and phrase phonology. Furthermore, different prosodic constituents correspond to different repairs of the same illicit segments, as illustrated with the Chilean data. Where non-transparent mappings occur alongside transparent outputs generated by different phonological operations, constraint reranking is required. Without it, two overlapping repairs cannot coexist as one will always be more harmonic. Moreover, outside of the realm of syntax, word structure requires closer scrutiny. It appears that stem-level derivation does not include coda aspiration, as demonstrated by alternations in morphologically derived words vs. their roots. Thus, three levels of derivation are indispensable in the grammar. This is the architectural strength of Stratal OT.

The model is convincing in at least two respects. First, it is economical – Chilean data evaluation is straightforward under two simple assumptions: there are three different levels of phonological operations, and there is a crucial but minimal reranking of the constraint set at their interface.⁵² No other problems arise under Stratal OT: there is no doubt about the nature of ‘operations’, the violation count or directionality. Second, Stratal OT captures the generalisation concerning the motivation of the weakening processes: coda /s/ is a marked segment and should be repaired. This can be effected either via debuccalisation or deletion. Word edges are especially vulnerable: here deletion is the prevalent repair unless another important repair can be made by filling an empty onset position.

Against this background, Harmonic Serialism does not seem to fare very well. Although it provides an interesting serial analysis of the data, it lacks the crucial division line between the word and the phrase. While the stepwise application of operations one locus at a time allows for making some promising predictions concerning the directionality of process application, the ban on reranking renders the model helpless when faced with Chilean opaque input strings. The incorporation of prosody intertwined with morphology, controlled by ALIGN and PARSE constraints, does predict some opaque patterns, but proves insufficient in the case of the dialect studied here. It seems, therefore, that building prosodic levels serially (as in Stratal OT) is superior to performing operations in a serial manner (as in HS), and minimal constraint reranking is a better structural tool than stepwise recursion of the same evaluation hierarchy.

[52] This is confirmed not only by the Chilean data. Numerous other processes present similar patterns, showing some degree of sensitivity to the word boundary in phrase phonology: linking and intrusive *r* in English, dark /l/ in English (e.g. Bermúdez-Otero 2007a), Quito Spanish /s/ voicing (Bermúdez-Otero 2011, Strycharczuk et al. 2014), obstruent voicing in Breton and Italian (e.g. Krämer 2001), lenition in Campidanian Sardinian (Łubowicz 2002, Tessier 2004), Corsican intersonorant voicing (Dinnsen & Eckman 1977), Bedouin Hijazi Arabic counterfeeding effects (McCarthy 2007, Wolf 2010) and many others.

Fragments of recordings analysed for the purposes of this paper

The [Appendix](#) shows several fragments of recordings made during an interview with two native speakers from Chile (Rodrigo and Jorge), and excerpts from televised interviews from cultural programmes broadcasted by the regional television from Iquique, northern Chile (ITV).

Each fragment starts with the orthographic transcription, followed by the phonetic transcription including all the relevant allophones. Words and expressions used in the paper as examples in (1) and (2) are marked in bold. Notes on the transcriptions are given at the end.

Rodrigo (age 32), 8 January 2011, Poland

(starting at 8 min 51 sec) *Yo estudié dos carreras, y nadie [de mis amigos] gana tan poco como gano yo. Y acá es caro, entonces no está bien, no vale la pena para nada, o sea, en **términos económicos**. En términos de vida, de conocer gente, estar en una cultura distinta sí vale, que me gusta mucho, me encanta Polonia. Pero claro, hay otros términos en que no nos conviene para nada Polonia.*

[dʒó ehtuðjé ðo karéra / i náðje ɣána tam póko komo ɣáno jó // i aká e^h káro entónse no ehtá βjen / no βale la péna para ná: o sea en **términoh ekonómiko** // en término ðe βíða / ðe konosér çénte / ehtár en una kultúra ðihtínta sí lo βále / ce me ɣú^hta mútfo / meŋkánta polónja // pero kláro / aj otjo términoh eɲ ce no kombjéne para ná: polónja]

Jorge (age 32), 8 January 2011, Poland

(starting at 1 min 40 sec) *Bueno, yo estoy en Polonia por ser músico acá. Trabajo como músico. Intento en realidad trabajar como músico. Vine acá como te contaba, conocí un grupo de folcloristas polacos en Brasil. Y vine acá por un **festival** y me gustó Poznan. Me gustó y me quedé. Soy músico, a **veces** también hago clases de español cuando hay cosas así, y eso en realidad ...*

[bwéno djo e^htój em polónja por ser músiko aká // traβáxo komo músiko // inténto en realiðá traβaxár komo músiko // bíne aká komo te kontáβa / konosí uɲ grúpo ðe folklori^hta polákoh en brasíl // i βíne aká por uɲ **fehtiβál** i me ɣu^htó pósnan // me ɣuhtó i me keðé // soɲ músiko / a βese tambjén ayo kláse ðe^hpajól kwando aɲ kósa:sí / i eso en realiðá]

(starting at 3 min 11 sec) *Todo eso también son temas difíciles de visas, de residencia. [...] Nosotros como chilenos no necesitamos una visa física para venir a Europa o a Polonia en este caso. Pero, cuando yo quise sacar **todos mis documentos**, les dije que bueno, nosotros tenemos un timbre en el pasaporte y eso es nuestra visa. Y esa visa dura por **tres meses**. Entonces al terminarse los tres meses tú tienes que volver a salir de la zona Schengen ...*

[toḡo éso tambjén son téma ḡifísile ḡe βisa / ḡe resiḡénsja // nosótro komo tʃiléno no nesesitamoh una βisa físika para βenír a európa o a polónja en e^{hte} káso // pero kwando jo císe sakár **to: mi ḡokuménto** le ḡiçe ce bweno / nosótro tenémoh un tímbrén el pasapórte i eso e nwe^{htra} βisa // i esa βisa ḡúra por **tré mése** // entónseh al terminárse lo tré mése tu tjéne ce βolβér a salír fwera ḡe la sóna tʃéjgen]

Cultural programmes, 31 January 2011 (ITV)

María Elena (age 40), Chile

(starting at 10 min 30 sec, talking about an educational project for schools) *Ellos abrieron la segunda etapa del concurso para **todas aquellas regiones** que no habían quedado seleccionados como un colegio de excelencia. Nosotros ganamos con el proyecto [...] Sin duda, a pesar de todos los tropiezos que tuvimos en el camino la reconstrucción de la escuela ya es una realidad ... [12 min 53 sec] Yo creo que sin duda no es lo único [que se puede hacer], pero ayuda. Ayuda a la competencia, ayuda a demostrar que es posible lograr lo que ha logrado el instituto nacional de Santiago, que tiene una cantidad de alumnos impresionante y el promedio y los resultados son realmente importantes y en la mayoría. No como en otros colegios que también siempre tienen ciertos contajes importantes, pero no son todos sino son algunos.*

[éjoh aβrjéron la seyúnda etápa ḡel kojúrso para **tóḡah acéja reḡjóné** ce no aβían ceḡáḡo seleksjonáḡa komo unkoléçjo ḡekselénsja // nosótro yanámo kon el projékto // sin ḡúa / a pesár ḡe toḡo lo trojéso ce tuβímoh en el kamíno la rekontuksjón de la e^{hwéla} djá es una realiḡá // aóra ehte koléçjo dekselénsja eh una partíḡa // djo kréo ce sin dúa no es lo úniko / pero ajú^{ḡa} // ajú^{ḡa} la kompeténsja / ajú^{ḡa}: ḡemo^{htrár} ce: posiβle loyrár lo ce a loyráo el in^{htitúto} nasjonal de santjáyo ce tjéne una kantiḡá ḡe alúmnoh impresjonánte / i el proméḡjo i lo^h resultáo son realménte importánte i en la mayoría // no komo en ótjo koléçjo ce tambjén sjempre tjénen sjérto kontaçe^h importánte / pero no son tóḡo sino son alýúno]

Juan (age around 40), Chile

(00 min 16 sec – 00 min 38 sec, talking about indigenous festivities) ***Las celebraciones**, conmemoraciones como esta, las fiestas religiosas, o las fiestas patronales son en alguna medida el espacio para que aquellos [los indígenas] se puedan expresar. Sin embargo también pueden existir **otros espacios** que permitan abrir este tema de los saberes culturales, no solamente de la perspectiva de indígenas, sino también no indígenas. Así el reconocimiento [de la gente de origen/de la cultura indígena] pasa a ser un tema fundamental.*

[**la seleβrasjóné** / konmemorasjóné komo é^{hta} / la fjé^{hta} relixjósja / o la fjé^{hta} patronále son en alýúna meḡía el e^{hpásjo} para ce acéjo se pweḡan ehpresar // sin embárçjo tambjén pwe:n eksi^{htir} **otroh ehpasjo** ke permítan aβrír e^{hte} téma ḡe lo

saβére kulturále / no solaménte ðe la per^hpektíβa ðe indíxena / sino tambjén nó indíxena // así el rekonosimjénto pása: ser un téma fundamentál]

Excerpts of a TV interview conducted with a local authorities representative in Tarapacá, Chile (Intendenta Regional Luz Ebensperger Orrego, age 47), 00 min 05 sec – 7 min 03 sec:

[on a government plan for Tarapacá region] *Creo que hemos tenido diez meses absolutamente intensos... y que hemos logrado formar un equipo cohesionado, con distintas visiones, y hoy en día tenemos un diagnóstico claro de la región, con sus **principales estrategias**, sus principales debilidades, sus principales fortalezas... que nos ha permitido trabajar en Plan Tarapacá... [...] pero no es una decisión tomada. Estamos en estudio para [...] El Plan Tarapacá, lo cierto, es un plan del gobierno a corto plazo... la estrategia regional es a largo plazo, hasta el dos mil veinte y sin duda todos los ejes del plan... [on infrastructure] **estamos en estudios preliminares para ver si esa es una solución viable...** [on water supply] *Nosotros ya por lo pronto este próximo año estamos partiendo con los temas de agua potable rural... es un tema que también hemos venido trabajando de acuerdo con la legislación vigente... pero aquí hay que hincar el diente en ... **las normativas** para...**

[kréo cémo teníðo ðjé méseh aβsolutaménte intenso / i ce:mo loγráðo formár un ecípo koesjonáðo / kon dihtínta βisjóné / i ójen día tenemoh un djaγnóhtiko kláro ðe la rexjón – kon su **prinsipáleh ehtatéxja** / su prinsipále fortalésa / ce noh a permitíðo tɾaβaxáren plán tarapaká // pero no eh una ðesisjón tomáða / ehtámoh en ehtúðjo para // el plan tarapaká lo sjerto eh um plan del γoβjérno a korto pláso / la ehtatécja reçjonal eh a larγo pláso / ahta el dó mil béinte i sin ðuðða toðo loh éçe ðel plán // **ehtámoh en ehtúðjo** preliminaré para βér si ésa eh una solusjón bjáβle / nosótro ja por lo prónto ehte próksimo áno ehtámo partjéndo kon lo tema ðe áγwa potáβle rural / eh un téma ce tambjén emo βeníðo tɾaβaxándo ðeakwérðo kon la leçislasjón biçénte / pero ací aĭ ce injkár el djénten / **la normatíβa** para //]

NOTES ON TRANSCRIPTIONS

Weak approximants

[β̞] voiced bilabial approximant

[ð̞] voiced dental approximant

[ɣ̞] voiced velar approximant

All these three sounds are allophones of /b d g/ and can be encountered after continuant sounds. Plosives appear in absolute initial position and after nasals (additionally [d] appears after /l/). The plosives can also at times be realised as stronger approximants or fricatives after consonants, in which case they are transcribed as [β̞ ð̞ ɣ̞]

Palatals

- [ç] voiceless palatal plosive encountered before high and mid front vowels (as an allophone of /k/)
- [ç̟] voiceless palatal fricative encountered before high and mid front vowels (as an allophone of /x/)
- [j] voiced palatal fricative encountered between vowels, represented by graphemes <ll> and <y>
- [dʝ] voiced palatal affricate encountered word initially and after nasals, allophone of [j]

Rhotics

- [r] multiple alveolar trill encountered in word-initial position and when corresponding to the grapheme <rr>
- [ɾ̟] voiceless alveolar fricative encountered in /tr/ clusters
- [r] alveolar tap encountered in the remaining contexts

Additional comments

In some cases, intervocalic voiceless stops are voiced to some degree, e.g. *nada Polonia* [ná: bolónja] ‘nothing Poland’. This phenomenon has been studied in some Spanish dialects, e.g. Canary Islands Spanish (Oftedal 1985), Majorcan Spanish (Hualde, Simonet & Nadeu 2011), Peninsular varieties (Lewis 2001), but literature on this change in Chilean is lacking (although research on the subject is currently under way by Dr Brandon Rogers, who gave a talk on the subject at the University of Concepción in Chile, entitled ‘La lenición de las oclusivas sordas /p t k/ como fenómeno sociofonético en el castellano hablado en Concepción, Chile: métodos e implicaciones’ [The lenition of voiceless stops /p t k/ as a sociophonetic phenomenon encountered in the Spanish spoken in Concepción, Chile: Methods and implications], 9 August 2017). For the time being, I ignore this type of (incomplete) voicing in the transcriptions.

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